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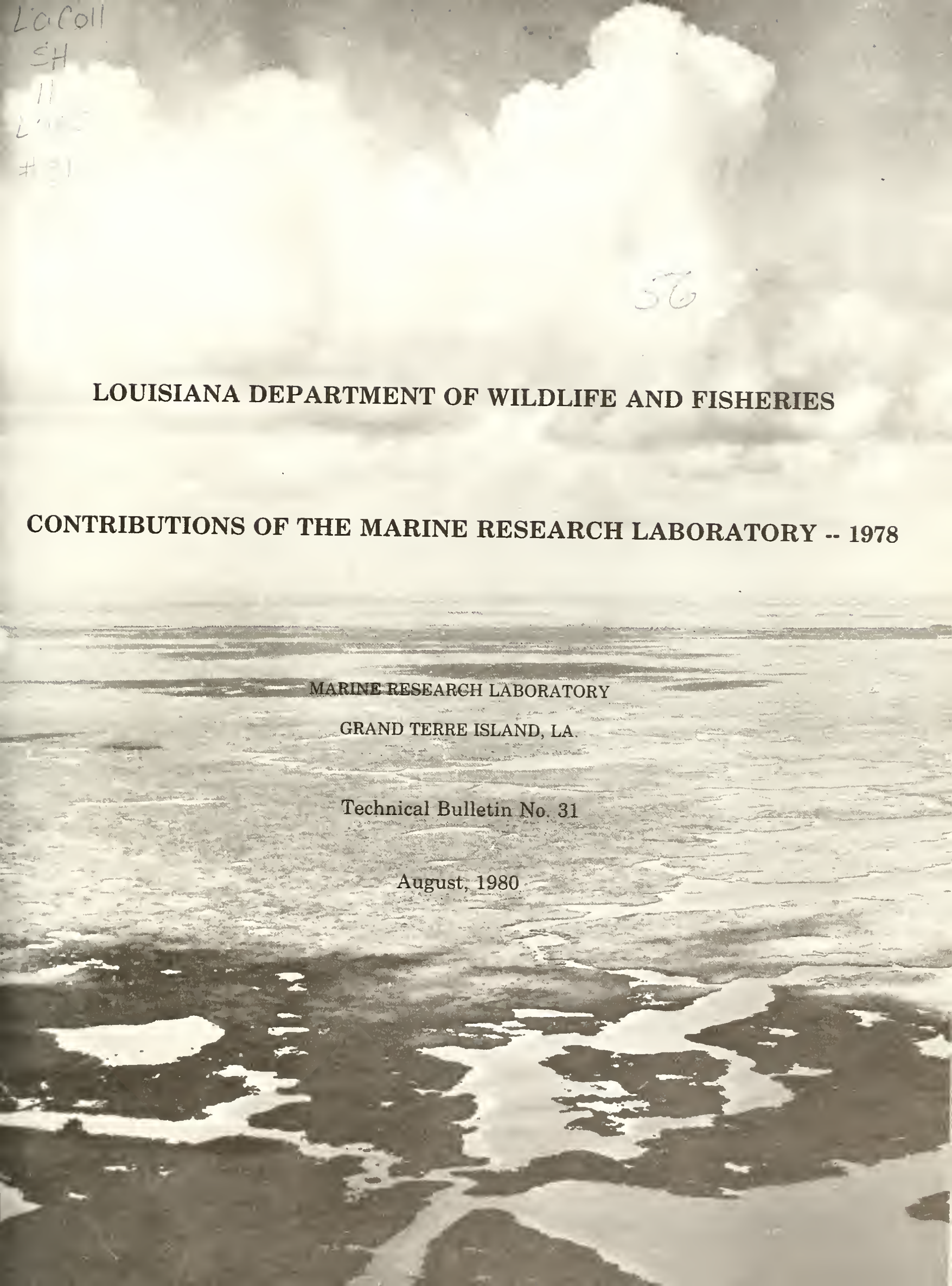

LOUISIANA DEPARTMENT OF WILDLIFE AND FISHERIES

CONTRIBUTIONS OF THE MARINE RESEARCH LABORATORY -- 1978

MARINE RESEARCH LABORATORY
GRAND TERRE ISLAND, LA.

Technical Bulletin No. 31

August, 1980

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Acknowledgments

These studies were completed through the cooperation and assistance provided by all the personnel of the Marine Laboratory Facility as well as by other people within the Seafood Division, without whose services these projects could not have been undertaken. A special thanks is extended to Myrtle Guidry for typing and for other clerical assistance that led to the completion of this report. The comments and criticism contributed by Messers. Harry E. Schafer, Jr., Max W. Summers, and William S. Perret are deeply appreciated. A very special thanks is extended to Claude Boudreaux for his assistance in editing the manuscript.

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Size Distribution, Length-Weight Relationships, Sex Ratios, and Seasonal Occurrence of King Mackerel *(Scomberomorus cavalla)* Off the Southeast Louisiana Coast

by
MYRON FISCHER

Abstract

There is a large sport fishery for king mackerel off the coast of Louisiana, with little or no commercial pressure on the species. Catch per unit effort varies widely on a seasonal basis. Populations of king mackerel are unusual in that they are composed predominantly of large females (up to 65 pounds), with the smaller males (up to 30 pounds) forming a small portion of the population (about 10%).

Introduction

The king mackerel *(Scomberomorus cavalla Cuvier)* is a coastal pelagic species highly sought by Louisiana anglers. Nationally, this fish is a highly valued commercial resource. In 1974, over 10 million pounds of king mackerel were landed commercially, which generated over 3 million dollars in dockside value (Bell and Fitz Gibbon 1977). Recent figures indicate that Florida landings alone have an annual value of over one million dollars. Louisiana, however, has no commercial interest in king mackerel; its sole value in Louisiana is as a sportfish. Although the exact dollar amount spent by sport fishermen to land king mackerel has not been determined, it is known to be sizable. In 1975, the total expense involved in all aspects of recreational saltwater fishing in the United States was 3.45 billion dollars. Nearly six million anglers engaged in deep-sea fishing and participated in 38 million fishing days (U.S. Fish and Wildlife Service 1977). We do not know what share of this was spent on the anglers quest for king mackerel; however, the popularity of the species would indicate that considerable effort was put forth toward their capture.

Because of the value of king mackerel, we must ensure that there will always be a supply plentiful enough to satisfy all user groups. To fully manage this valuable fishery, we must fill in the many gaps in our present knowledge of the king mackerel in coastal Louisiana water.

The location of this project - southeast Louisiana - is believed to be unique because of the large size of overwintering king mackerel. The results of monitoring the seasonal king mackerel distribution and the physical characteristics associated with this distribution form the basis of this paper.

MATERIALS AND METHODS

All king mackerel sampled during this project period were obtained from sport fishermen. Only rods and reels were used to capture the mackerel because there is no active commercial industry for king mackerel in this area.

The ports sampled include Empire, Grand Isle, and Port Forchon (Figure 1). These three areas have 66 percent of the charter boats in the State of Louisiana. A major portion of the private sport fishing vessels also use these areas as their ports of entry. Dockside creel data indicate that the area fished ranges west from the Mississippi River to Bayou Lafourche and seaward to the 50 fathom bottom contour.

We obtained permission from the anglers to use their fish for study purposes. Our sampling began once the sport fishing vesells were secure in their berths and their catch was unloaded. The king mackerel were tagged for identification and weighed to the nearest tenth of a pound on a Maco bench beam scale. Both fork length and total length were measured in millimeters, and the sex was determined. The captain was interviewed to determine the extent of the fishing effort on that fishing day.

Data were collected for a one-year period from December 1, 1977, to November 30, 1978. Length-weight relationships, fork length-total length relationships, sex ratios, size frequency, and relative abundance were calculated.

RESULTS AND DISCUSIONS

Dockside interviews indicated that 2243.8 hook hours yielded a catch of 431 king mackerel. Defining one hook hour as one unit of effort, this result is a

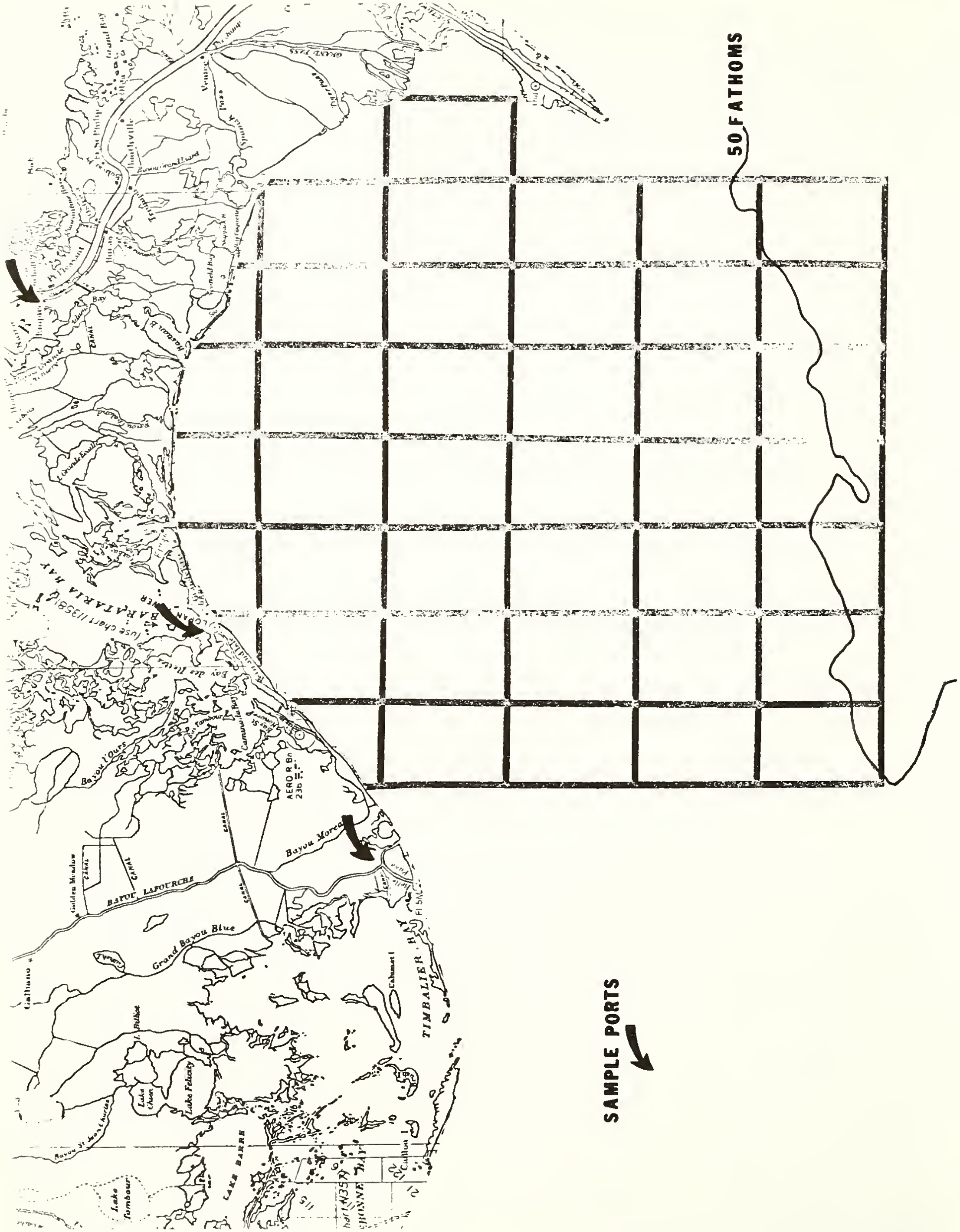

Figure 1. Map of area and sampling grid.

0.192 catch per unit effort (CPUE), or 192 fish per 1000 hook hours. Converting this into time to catch one king mackerel, we arrive at a catch rate of one fish per 5.21 hours fished per hook (rod).

Weather appeared to be the primary factor affecting the amount of effort exerted. The sports fishermen fished mostly on weekends, which, because of the limited time span, are more adversely affected by foul weather. To partially eliminate weather conditions and group the data in a meaningful and useful fashion, the data were grouped into seasons or quarters. Also, grouping by seasons is beneficial because the method of fishing and the fishing locations fluctuate from season to season but remain virtually the same within seasons. The first quarter (winter) included December, January, and February; the second quarter (spring) included March, April, and May; the third quarter included June, July, and August; the fourth quarter (fall) included September, October, and November.

Catch per unit effort was calculated and graphed monthly as wll as quarterly (Figure 2). This graph shows radical monthly changes in CPUE, partly because of the limited effort exerted in certain months when the weather prevented the fishermen from venturing far offshore. Averaging the data on a quarterly or seasonal basis yields a much smoother curve and illustrated the overall catch efficiency.

The highest months with the highest CPUE were November, January, and December, with a 0.792, 0.739, and 0.600 CPUE respectively. The lowest catch efficiency was in March (0.012 CPUE) and February (0.045 CPUE). The king mackerel catch breaks down as follows:

$$\text{First Quarter} - \frac{113 \text{ fish captured}}{334.5 \text{ hook hrs. exerted}} = 0.338\,\text{CPUE}$$

$$\text{Second Quarter} - \frac{120 \text{ fish captured}}{968.0 \text{ hook hrs. exerted}} = 0.124\,\text{CPUE}$$

$$\text{Third Quarter} - \frac{53 \text{ fish captured}}{312.0 \text{ hook hrs. exerted}} = 0.170\,\text{CPUE}$$

$$\text{Fourth Quarter} - \frac{145 \text{ fish captured}}{629.3 \text{ hook hrs. exerted}} = 0.230\,\text{CPUE}$$

To illustrate quarterly size distribution, histograms comparing the weight in five-pound groups versus the frequency of occurence were plotted (Figures 3-6). A wide distribution was evident during all seasons. A definite peak in one size group was noted in all seasons, except in winter. The winter population seemed to contain all size groups uniformally.

The number of fish sampled in each quarter varied greatly. The actual number of fish sampled is a function of pressure exerted, fishing efficiency, and sampling effort. To place the data in the histograms on comparable units, the frequency of occurrence was converted into percent of occurrence. The conversion eliminated differences in the quantity of data points in various quarters and placed all data on an equal 100 percent basis.

Figures 7-10 give the seasonal occurrence of king mackerel in five-pound groups versus their percent occurrence. The peaks in these graphs can be directly compared to each other. This table only indicates size distribution and does not indicate the actual abundance in each group. It is evident from Figures 3 to 10 that the larger fish occur during the spring and that the smaller fish are more numerous during the summer and fall.

The catch per unit effort is the rate of efficiency of the anglers. This catch per unit effort is proportional to the stock present and, therefore, is an index of abundance (Ricker 1958). To enter the efficiency of the anglers into this situation, we multiply the frequency of occurrence of each group by the CPUE and obtain a relative abundance (Figures 11-14). This relative abundance is used in the strict sense that the calculated abundance in five-pound groups is only relative to other groups in the limits of this project. Using this relative abundance, we can compare specific patterns in various size groups throughout the year.

The physical aspects of the king mackerel sampled, the fork length (FL) and total length (TL), were compared on a linear regression (Figure 15). The resulting relationship between fork length and total length is:

$$\begin{aligned} TL &= 1.0131\,(FL) + 51.50 \\ FL &= 0.9700\,(TL) - 50.63 \end{aligned}$$

The ability to convert from fork length to total length, or vice versa, is valuable when comparing data points acquired by various methods. Sport fishermen and others involved in the recreational interest prefer measuring fish in total length. Most biological data are recorded in fork length or standard length (Lagler 1952). Beaumariage (1973) has worked out the linear regression relating fork length to standard length. Incorporating Beaumariage's equations and the ones listed above, one can convert data from any one length measurement to another.

The sex ratio and weight range of each sex are probably the most unusual aspect of the fishery in this area. Of 558 fish sexed, 92.7 percent were female

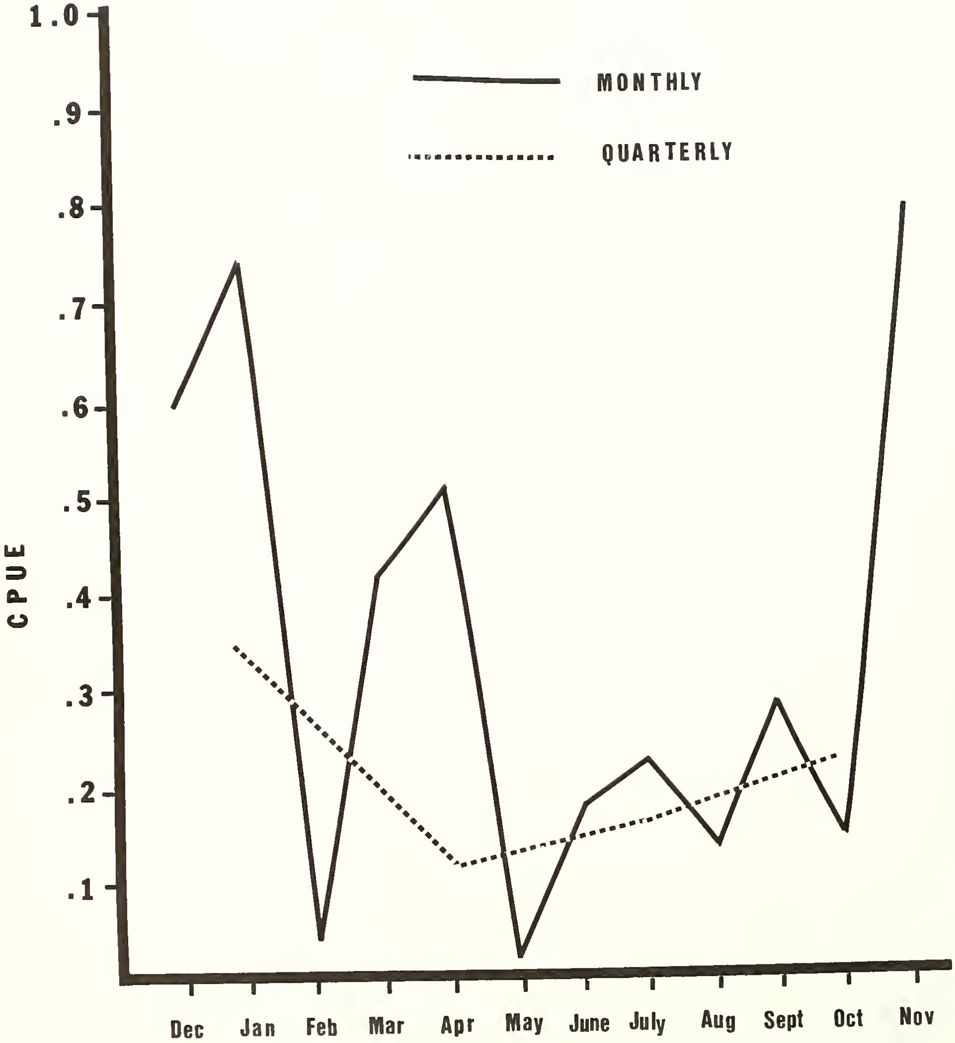

Figure 2. Monthly and quarterly catch per unit effort (CPUE).

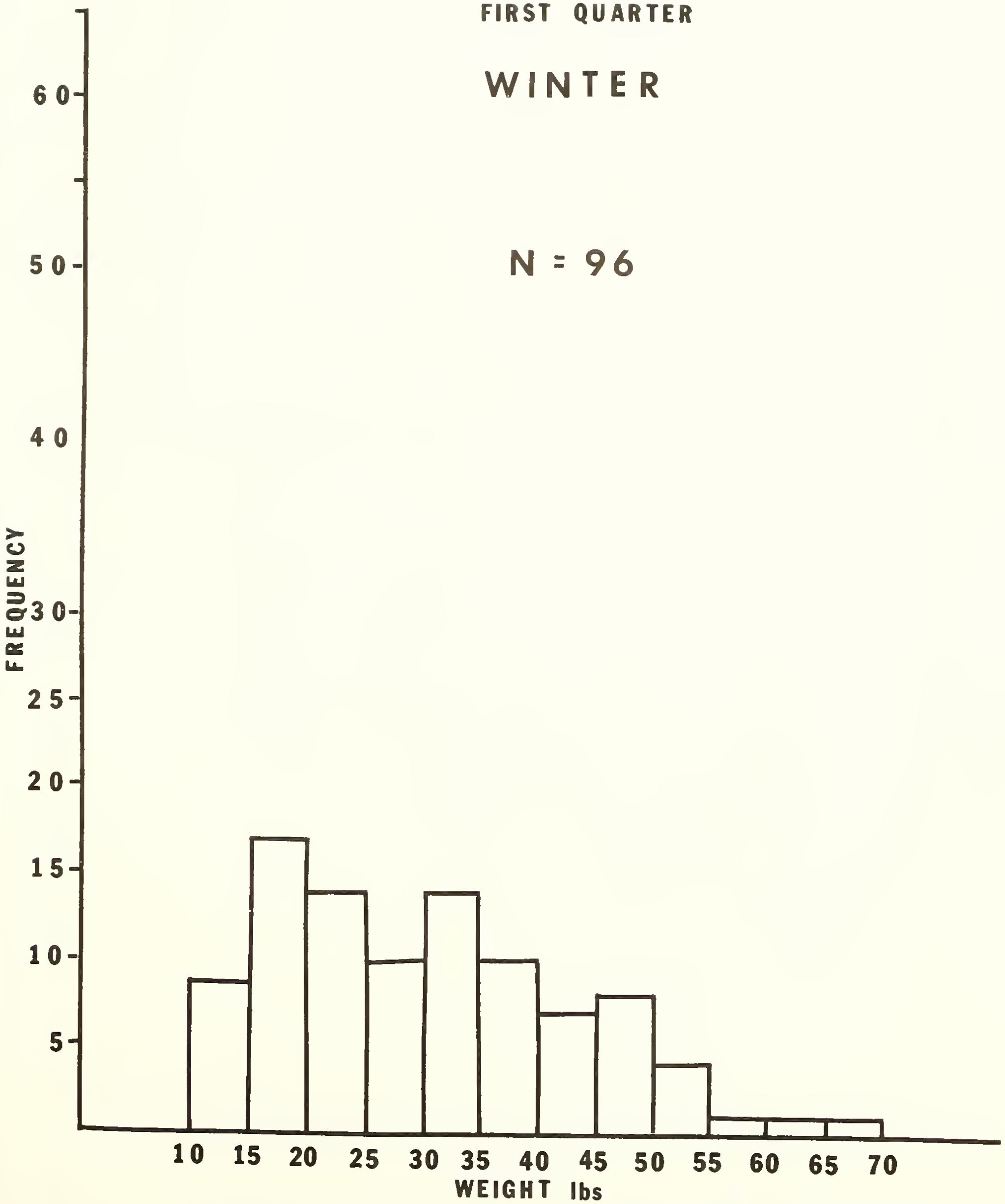

Figure 3. Weight frequency histogram for the winter months (Dec., Jan., and Feb.).

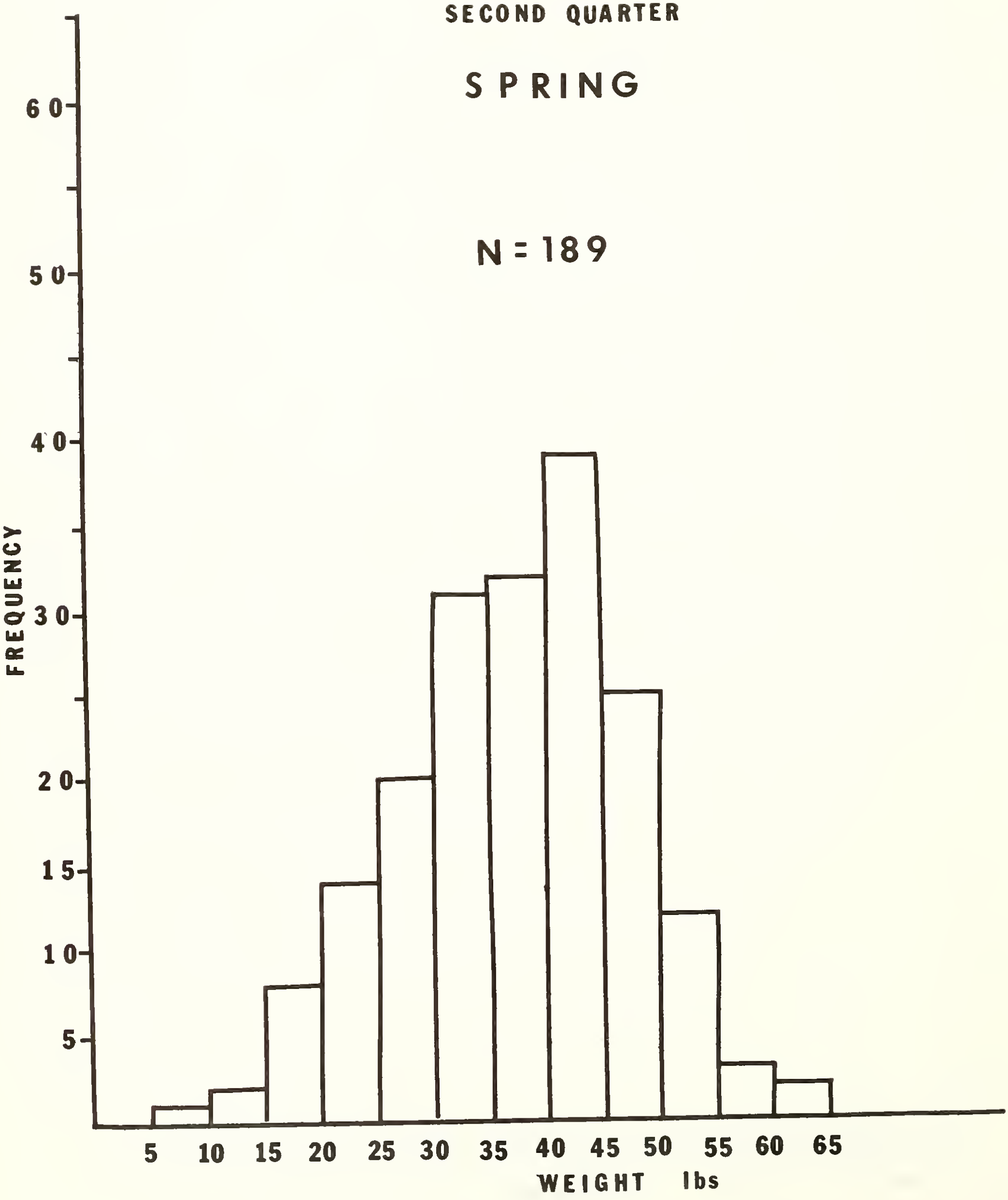

Figure 4. Weight frequency histograms for the spring months (Mar., Apr., and May).

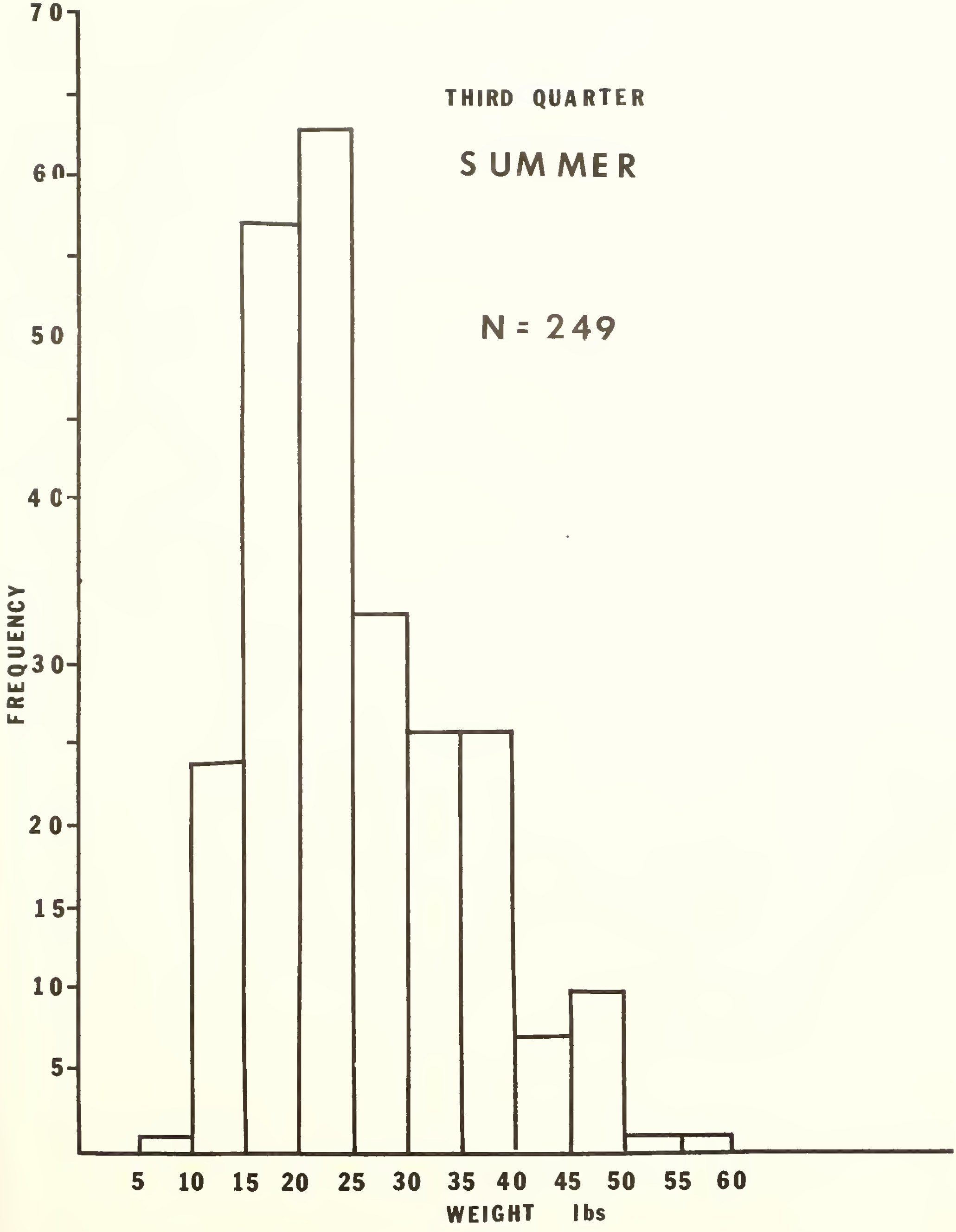

Figure 5. Weight frequency histogram for the summer months (June, July, and Aug.).

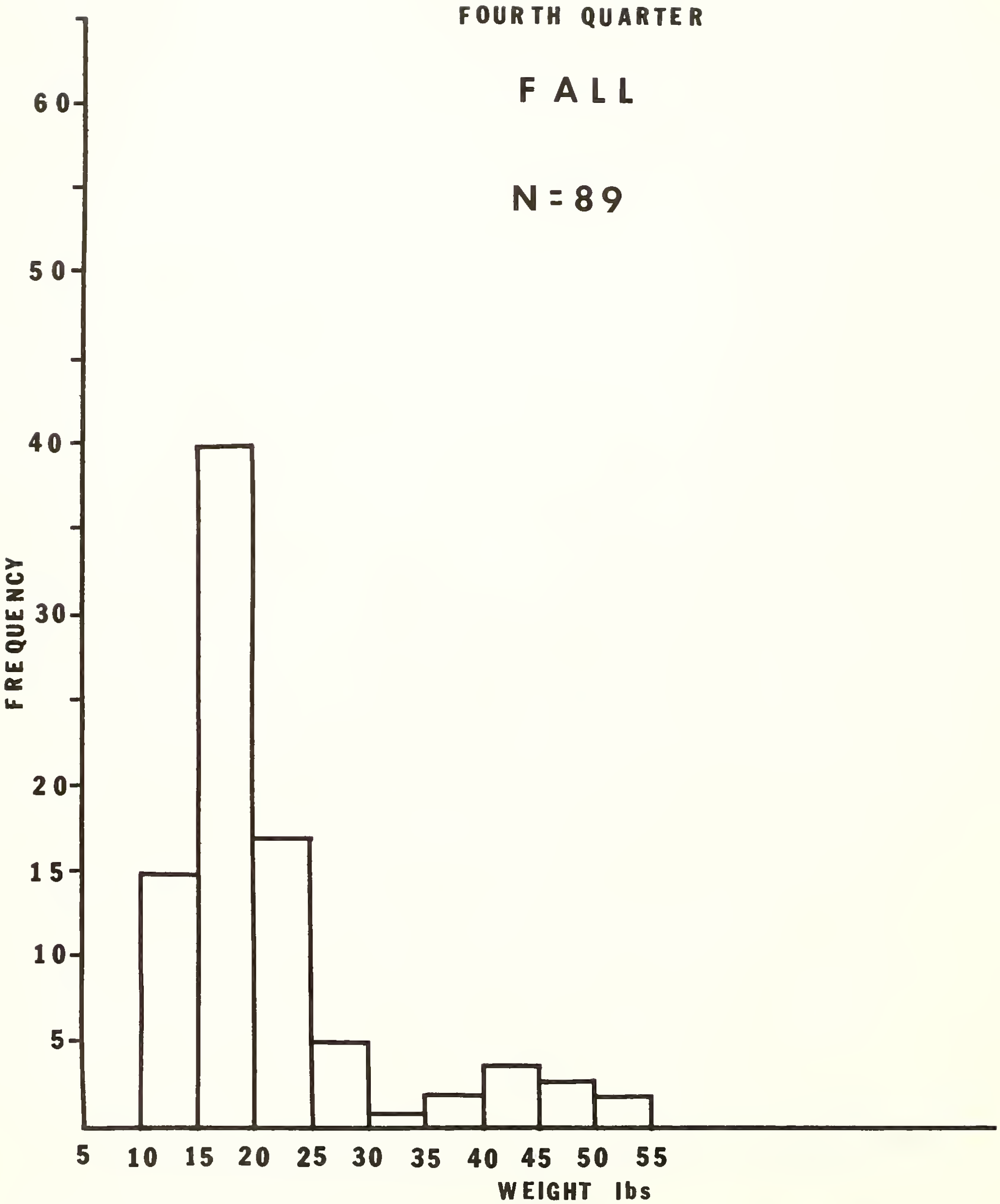

Figure 6. Weight frequency histograms for the fall months (Sept., Oct., and Nov.).

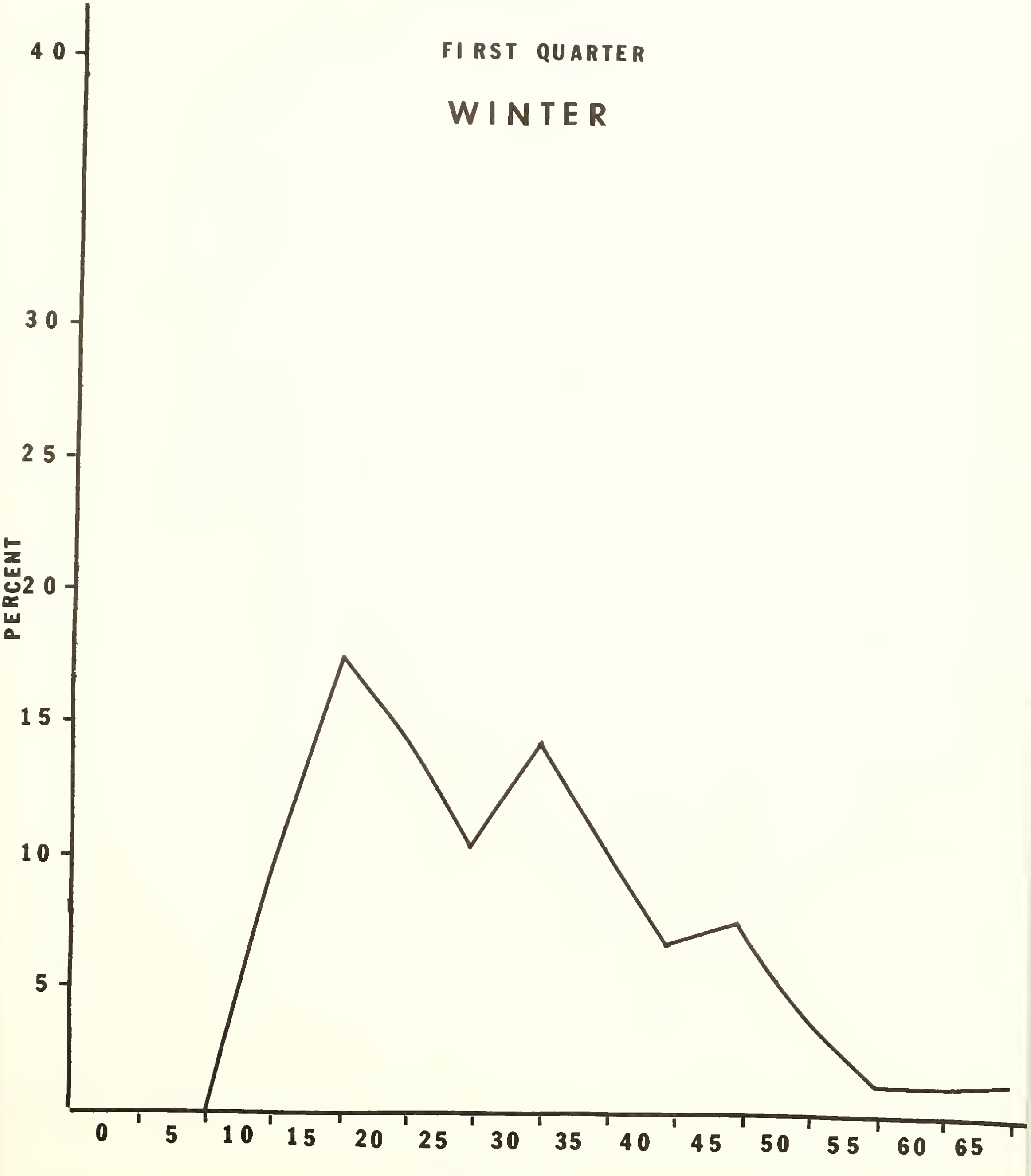

Figure 7. The percent occurrence for the different weight fish for the winter months (Dec., Jan., and Feb.).

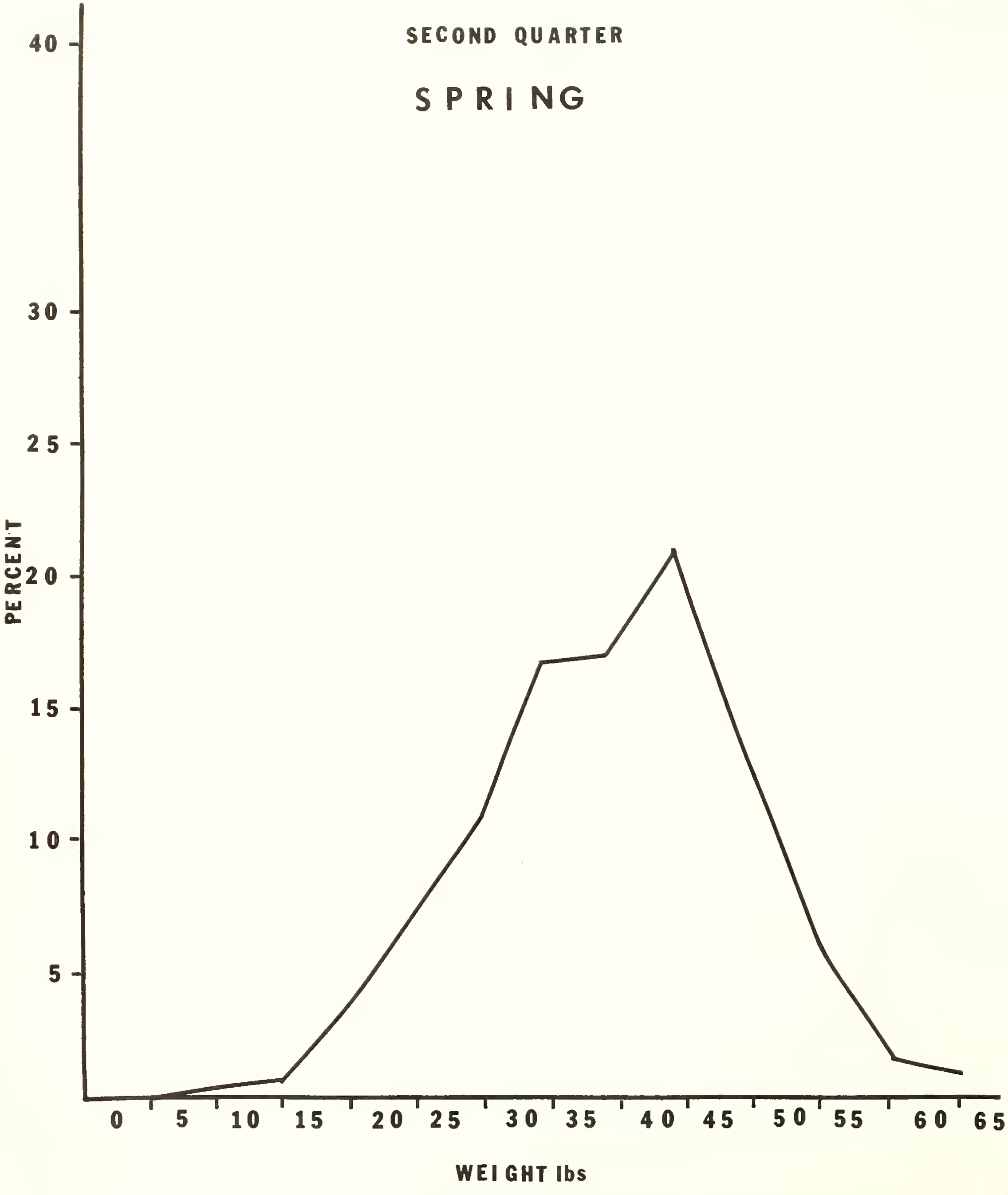

Figure 8. The percent occurrence for the different weight fish for the spring months (Mar., Apr., and May).

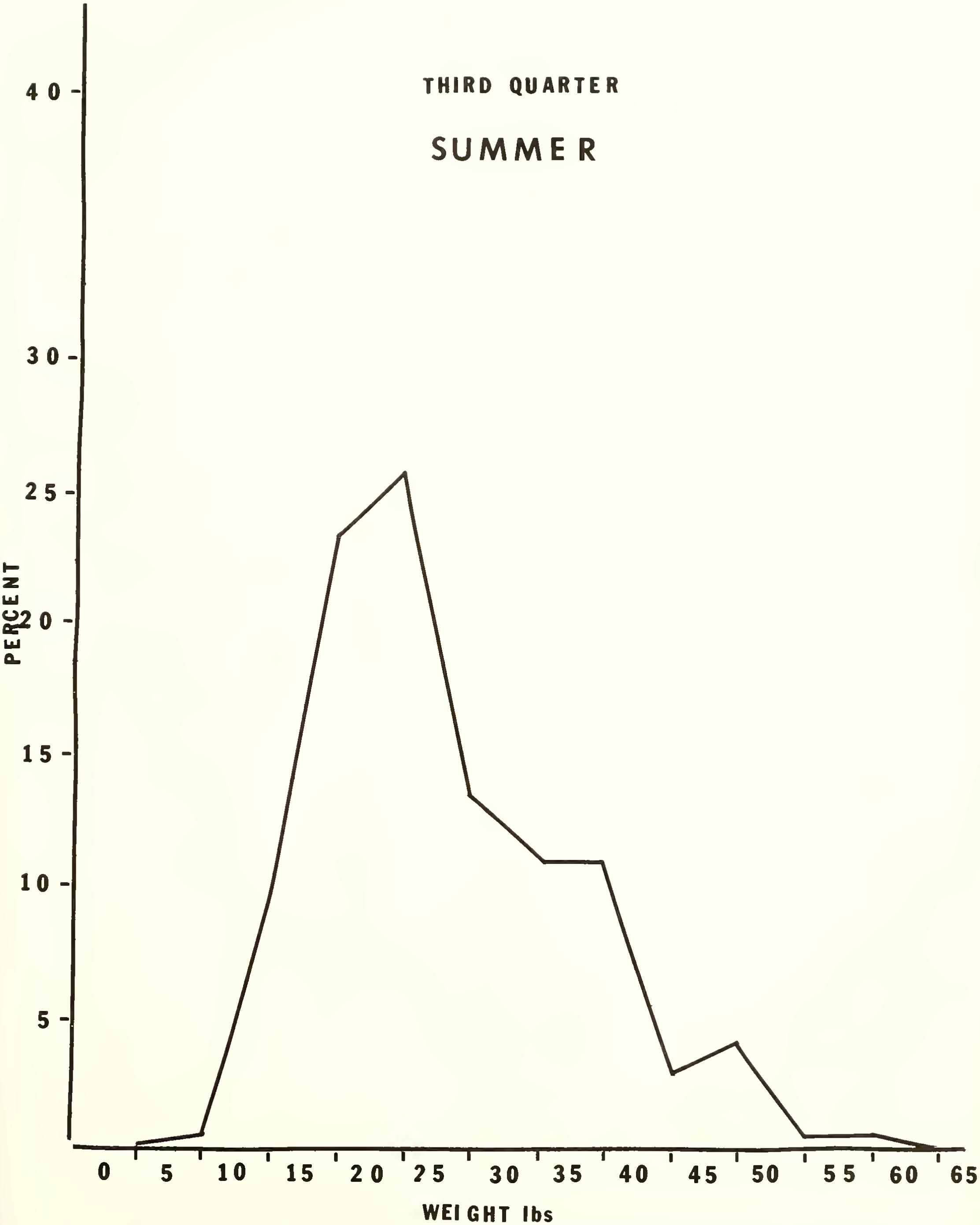

Figure 9. The percent occurrence for the different weight fish for the summer months (June, July, and Aug.).

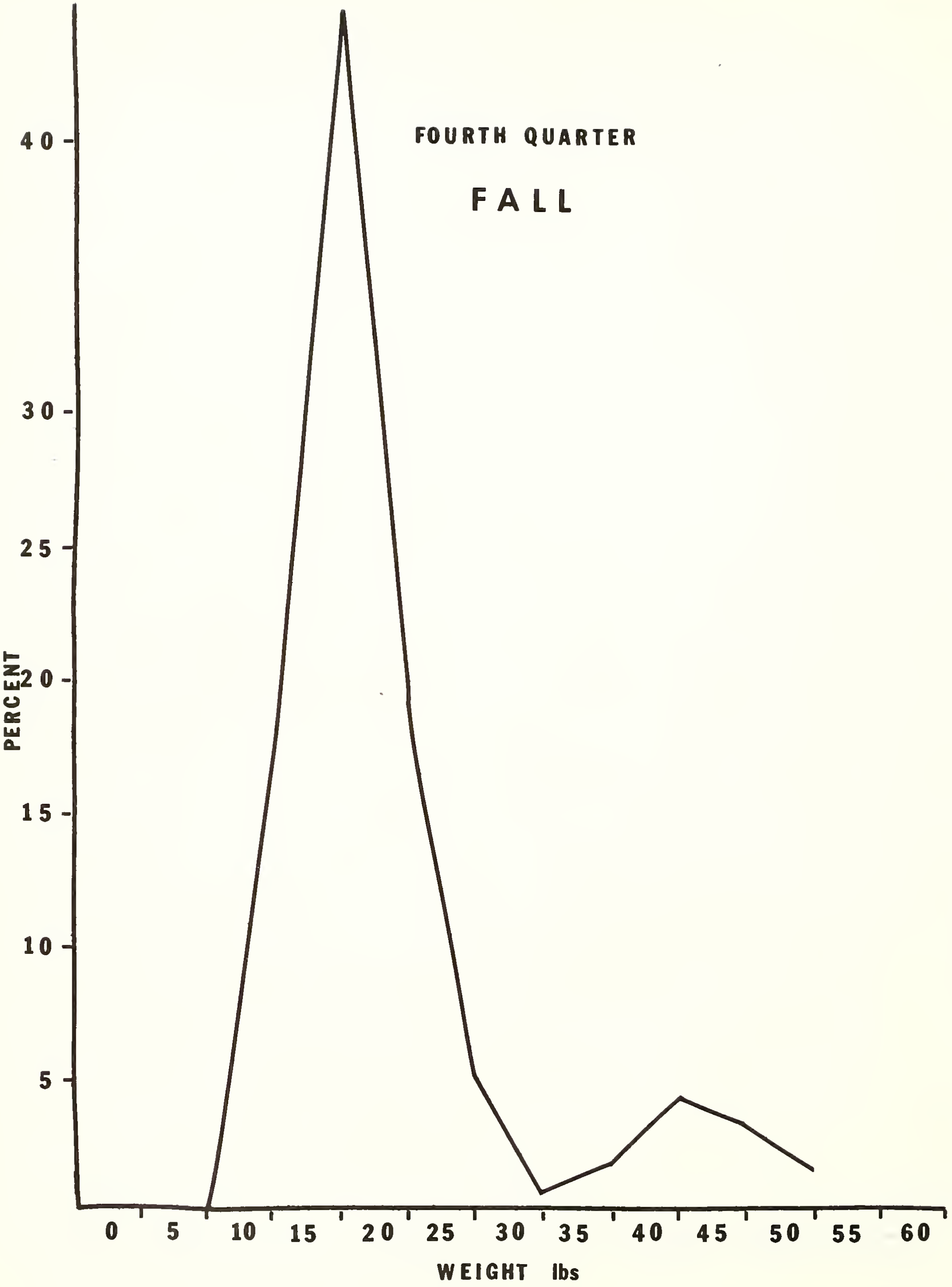

Figure 10. The percent occurrence for the different weight fish for the fall months (Sept., Oct., and Nov.).

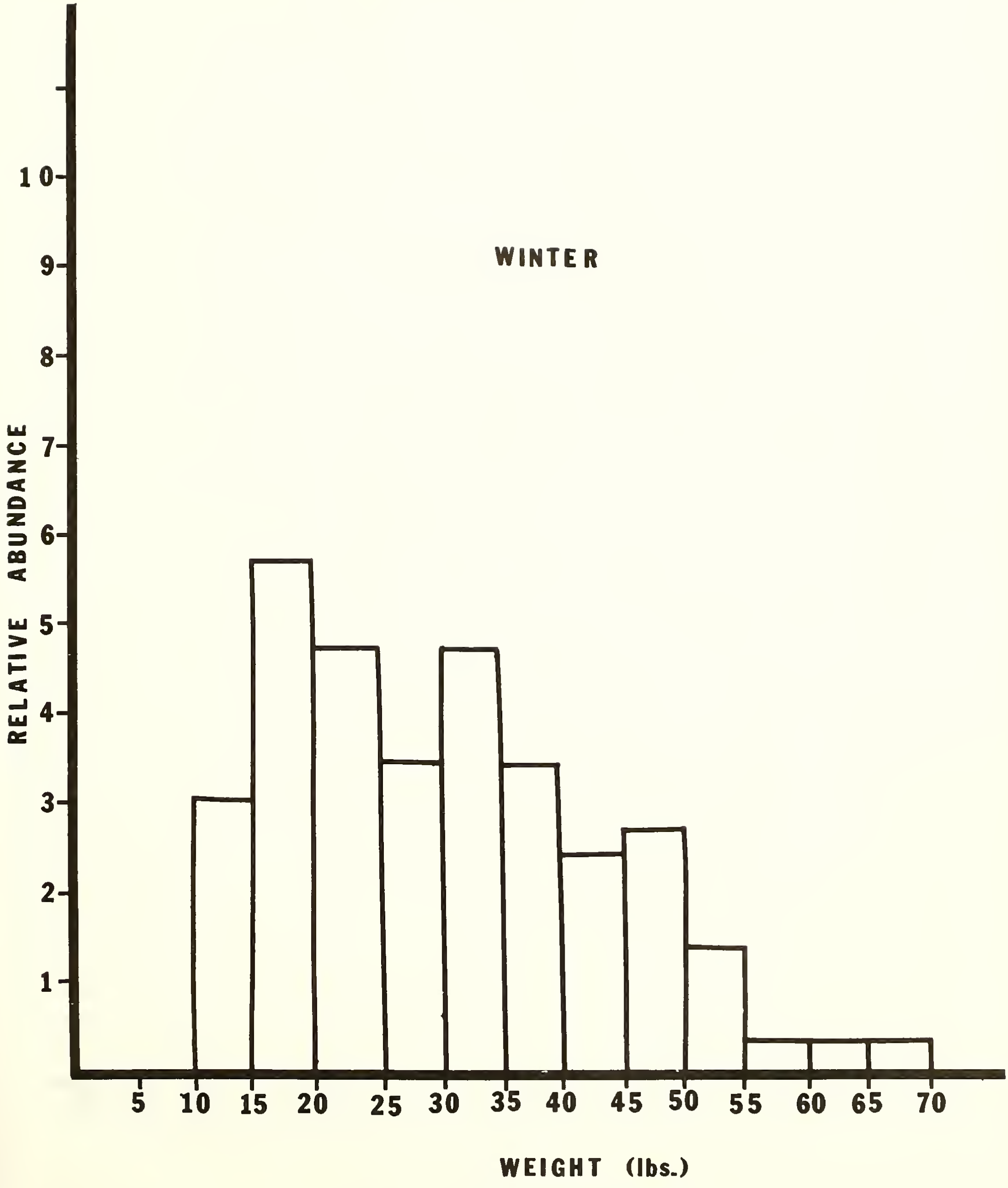

Figure 11. Relative abundance with respect to weight for the winter months (Dec., Jan., and Feb.).

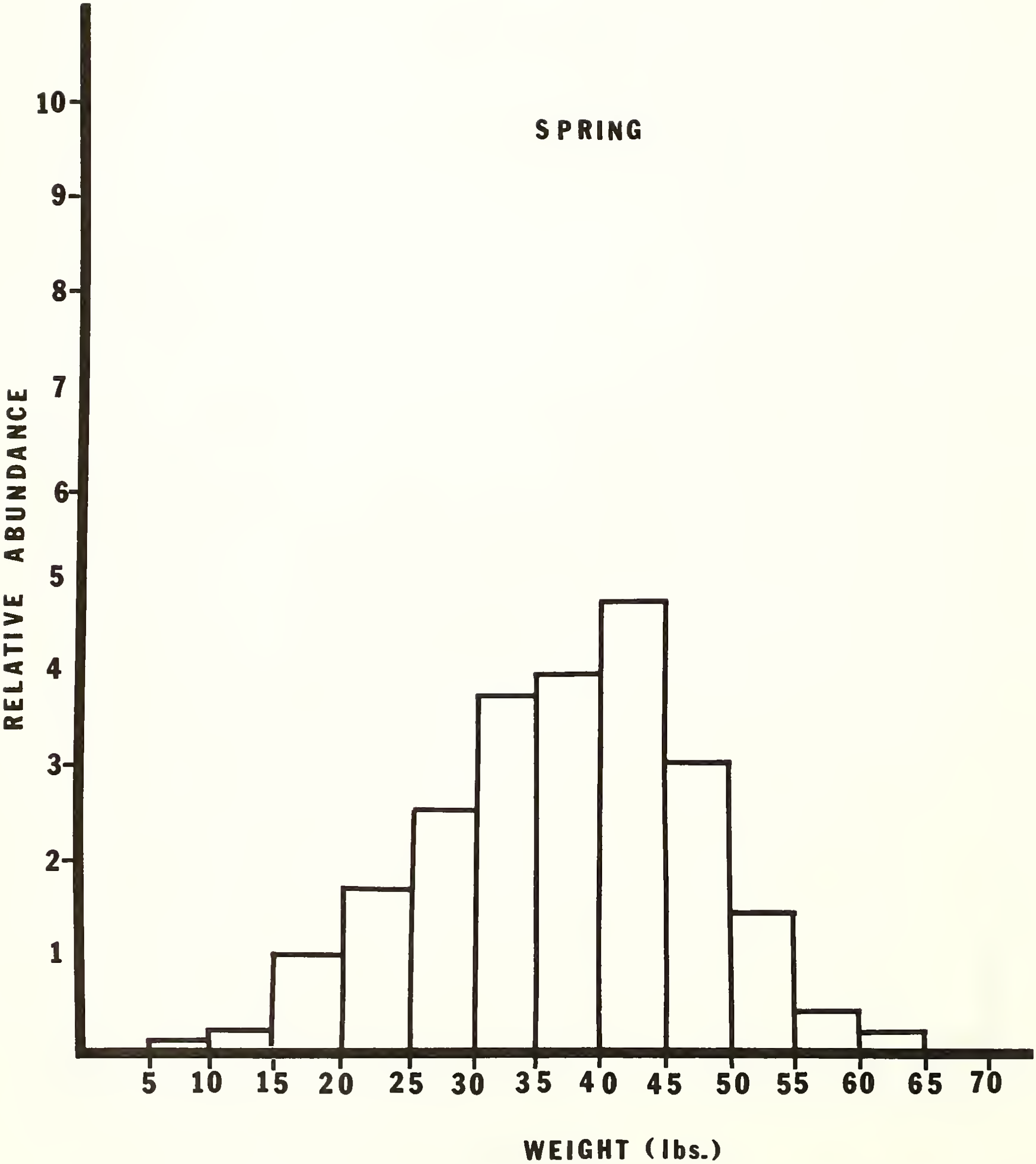

Figure 12. Relative abundance with respect to weight for the spring months (Mar., Apr., and May).

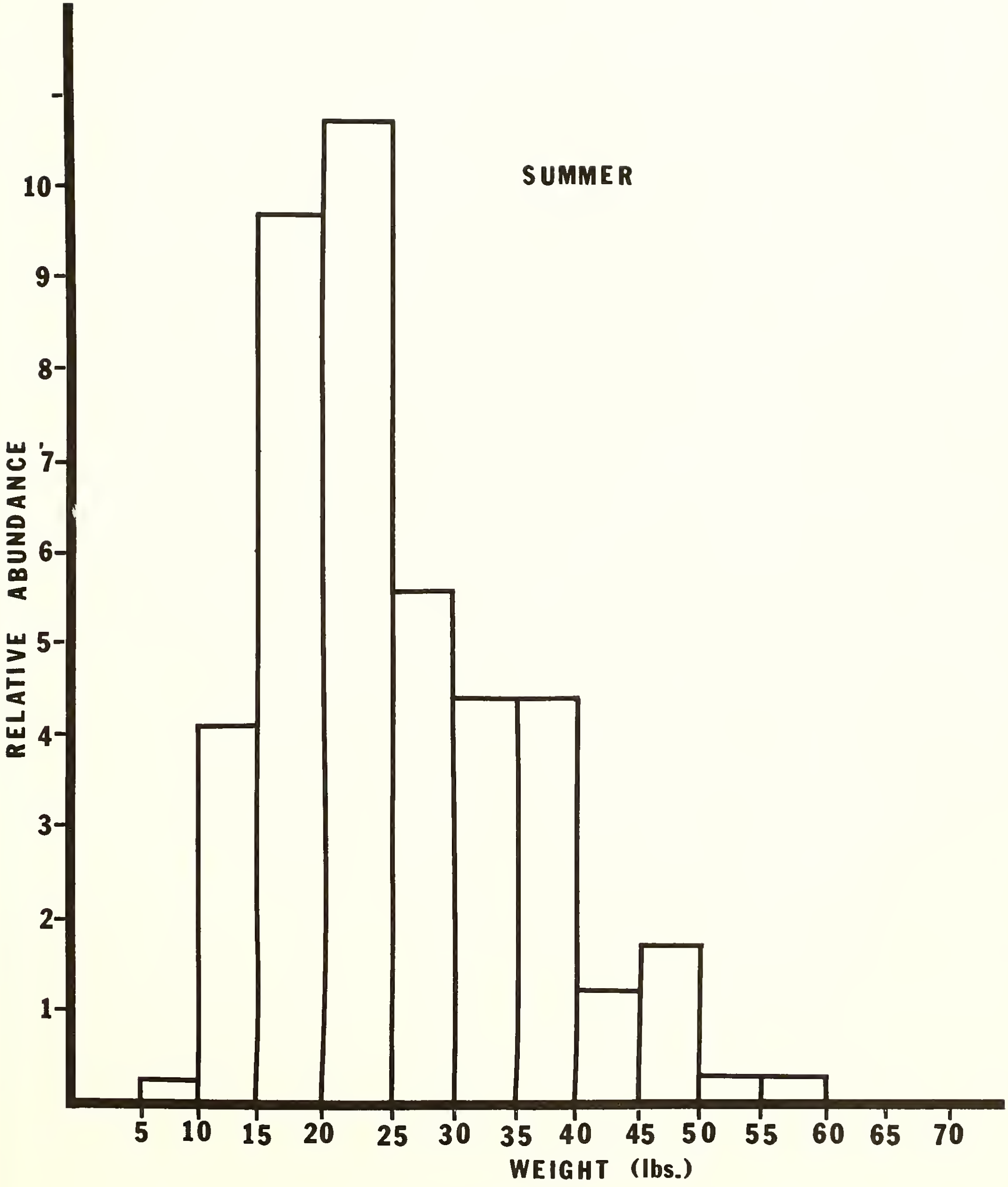

Figure 13. Relative abundance with respect to weight for the summer months (June, July, and Aug.).

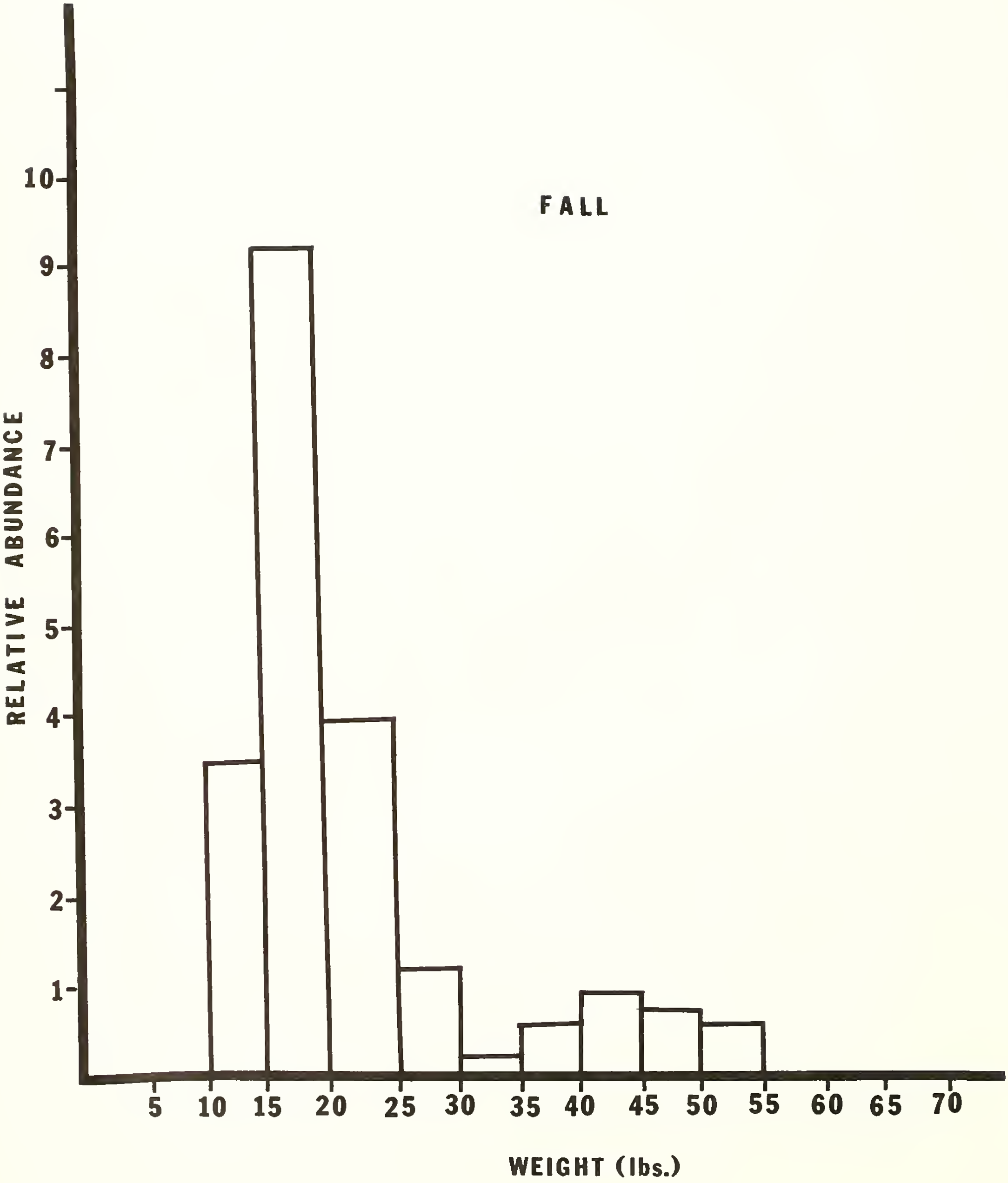

Figure 14. Relative abundance with respect to weight for the fall months (Sept., Oct., and Nov.).

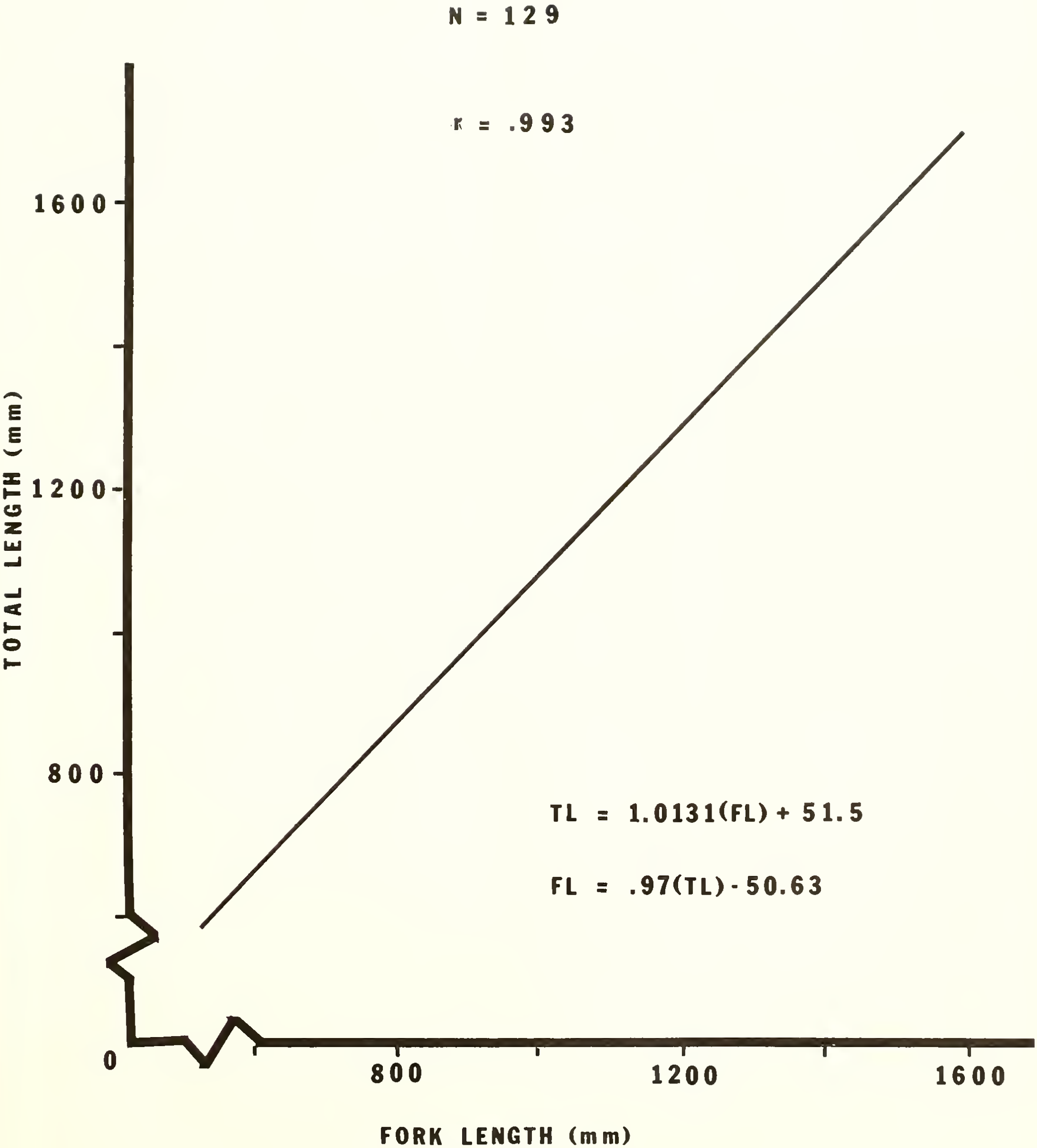

Figure 15. Total length-fork length distribution for king mackerel *(Scomberomorus cavalla).*

and 7.3 percent were male. The quarterly breakdown of sex ratio expressed in percent and weight range of each is as follows:

First Quarter -	males	7.4%	12.7 lbs to 19.8 lbs
	females	92.6%	14.6 lbs to 67.3 lbs
Second Quarter -	males	3.1%	12.7 lbs to 27.6 lbs
	females	96.9%	8.5 lbs to 62.4 lbs
Third Quarter -	males	10.4%	10.9 lbs to 19.5 lbs
	females	89.6%	12.6 lbs to 53.3 lbs
Fourth Quarter -	males	3.4%	14.0 lbs to 16.3 lbs
	females	96.6%	12.0 lbs to 52.8 lbs

It is obvious that the population's sex ratio leans very heavily toward the female. By comparing the weight range of both sexes, we find that the males comprise the lower end of the scale (Figure 16).

A length-weight comparison (Figure 17) was plotted for 500 females and 38 males. The extreme difference in these numbers illustrates the 93 percent female population found in Louisiana waters. With the weight in grams and the length in millimeters, the linear regression of the common logarithm (base 10) of length-weight area:

$$\text{Males } \log_{10}\text{wt} = 3.5348 \log_{10}\text{FL} - 6.7162$$
$$\text{Females } \log_{10}\text{wt} = 3.2906 \log_{10}\text{FL} - 5.9990$$

The curvilinear regression for the relationship W - aL^b calculated for each sex separately is:

$$\text{Males W} = 1.922 \times 10^{-7}L^{3.535}$$
$$\text{Females W} = 1.002 \times 10^{-6}L^{3.291}$$

This length-weight relationship compares very closely to Beardsley and Richards (1970) where, with sexes combined, they determined a relationship of W = $2.70 \times 10^{-6}L^{3.23}$ for nearly 200 mackerel.

Beardsley and Richards	3.23 slope	5.568 y intercept
Fisher	3.29 slope	5.999 y intercept

SUMMARY

The average annual catch per effort in Louisiana water is 0.192, or one fish per 52.1 hook hours. The CPUE was highest in November (0.730 CPUE), January (0.730 CPUE), and December (0.600 CPUE) and was lowest in May (0.015 CPUE).

Weight frequency histograms and weight versus percent occurrence graphs indicate that the larger fish are more numerous during spring and the smaller fish are more numerous during summer and fall.

In terms of relative abundance, the mode of the population lies in the 20 to 25 pound group, which occurs in larger abundance during the summer. The population contains many fish up to 45 pounds, and these fish are more numerous during spring.

The total length (TL) and fork length (FL) relation of these fish forms a linear regression. The correlation coefficient is 0.933 for the relationship:

$$\text{TL} = 1.0131\ (\text{FL}) + 51.5$$

The king mackerel sex ratio is 12.7:1, or 92.7 percent female. The females appeared to be much heavier than the males, and weighed up to 67.3 pounds. The largest male king mackerel weighed in at 27.6 lbs.

The curvilinear regression for the relationship between length and weighed in the form of the equation W = aL^b is:

$$\text{Males W} = 1.922 \quad \times \quad 10^{-7} \quad L^{3.533}$$
$$\text{Females W} = 1.002 \times 10^{-6}\ L^{3.291}$$

The linear regression of the common logarithm (base 10) of length and weight are:

$$\text{Males } \log_{10}\text{wt} = 3.5348_{10}(\text{FL}) - 6.7162$$
$$\text{Females } \log_{10}\text{wt} = 3.2906 \log_{10}(\text{FL}) - 5.9990$$

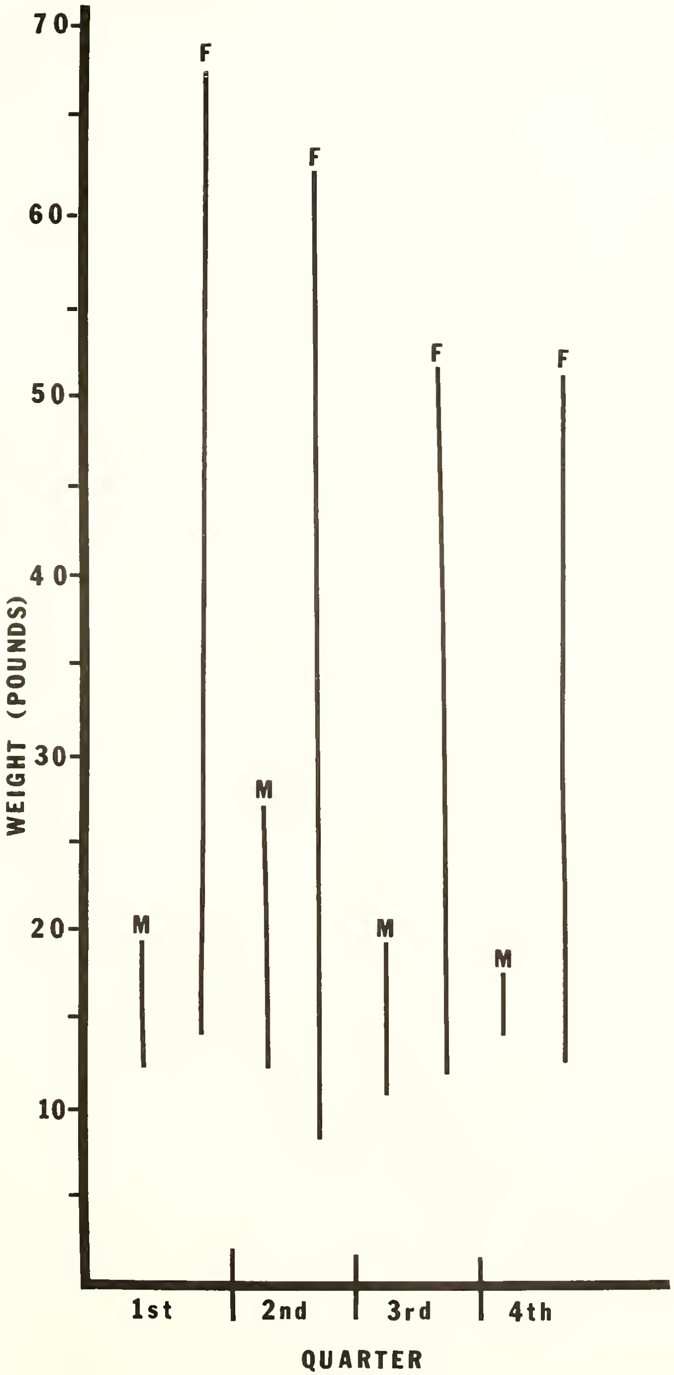

Figure 16. Weight range by sex by quarter for the king mackerel *(Scomberomorus cavalla)* offshore Louisiana.

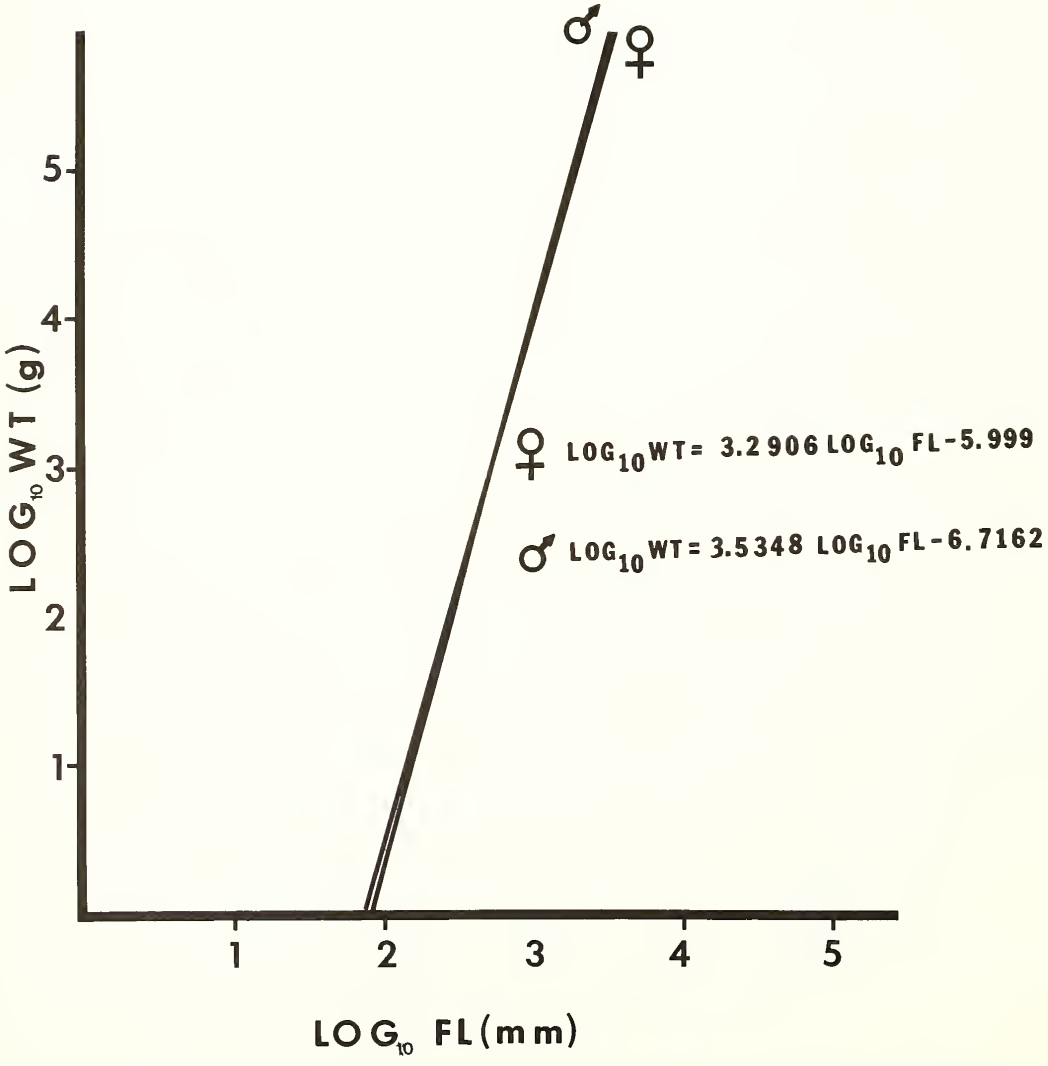

Figure 17. Length-weight relationship for male and female king mackerel *(Scomberomorus cavalla)* taken offshore Louisiana.

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A Status Report on Commercial Clamming Efforts in Louisiana

by
RONALD J. DUGAS

Introduction

There are at least 12 species of clam harvested commercially in approximately 16 different states within the continental United States. The total United States commercial clam catch in 1975 (as reported by the National Marine Fisheries Service of the U.S. Department of Commerce) amounted to 113.2 million pounds and had a dockside value of approximately 44 million dollars.

Those species of primary importance commercially are the surf clam *(Spisula solidissima)*, soft clam *(Mya arenaria)*, ocean quahaug or mahogony clam *(Artica islandica)*, sunray clam *(Morocallista nimboas)*, hard clam or quahaug *(Mercenaria mercenaria)*, and the southern quahaug *(Mercenaria campechiensis)*. Littleneck (1 to 1-7/16 inch in width) cherrystone (1-7/16 to 1-5/8 inch) and chowder (1-5/8 inch and larger) are all size variations of *Mercenaria*.

The commercial harvesting of hard clams employs the largest number of people of all the clamming operations in the United States and has the highest ex-vessel value of all the clam industries; however, it ranks second behind the surf clam industry in total volume of meats produced. Prior to 1977, there were no reported efforts to commercially harvest clam meats in Louisiana. Harvesting might have been occurred on a small scale within local groups, but none has ever been reported in the literature. There simply has been no commercial market for clam meat within Louisiana. However, with the dwindling surf clam supplies on the East Coast and with the relocation of many people from the East Coast to the Gulf States, there has been a recent interest in Louisiana hard clams. This interest has prompted a local oyster corporation to invest some time and energy into determining the feasibility of marketing the local clam.

Biology

The biology of the hard clam *(Mercenaria sp.)* has been described by numerous investigators, primarily for the northern species. The following are some of the pertinent facts.

Fertilization of the egg is external. The total number of eggs produced ranges from 8 to 40 million and averages 24.6 million. After hatching, the organism progresses through a series of larval stages and is free-floating for a period of about 20 to 30 days. The larva develops a foot and settles to the bottom where it can either swim or crawl. At about 1-1/2 years of age (approximately 62 mm in length) the sexual development of the clam begins, and by the time the clam has reached two years of age, it is fully reproductive. The life span of the hard clam can be as long as 17 years. Spawning occurs when the temperature exceeds 20°C. In Rhode Island, there is apparently a bimodal spawning peak, with one peak beginning in May or June and continuing through the summer and with another peak in September or October. Clams taken in Breton Sound, Louisiana, during October 1976 were observed to be spent or spawned out.

The hard clam becomes quiescent at temperatures of 5°C or less and is then not affected by quality of the overlying water. These clams have shown a diurpal rhythm with maximum and minimum feeding activity occurring in the afternoon and early morning, respectively, and also have been shown to react to tidal rhythm and lunar cycles.

The optimum salinity for growth of clam larvae after they reach the straight-hinge state is 27.5 parts per thousand (0/00) or higher. 15.0 0/00 is the lowest salinity at which clam larvae were successfully reared to metamorphsis.

Exploratory and Harvesting Results

In June 1976, I was asked by Ralph Pausina to help his corporation to locate a commercial concentration of clams in Louisiana waters. During June, he was issued an exploratory fisheries permit. A one-week cruise was made in July to locate potential clamming areas and to adapt the oyster vessel to fishing clams. At this time the emphasis was on the chowder clams. A conventional oyster dredge and a clam dredge from an East Coast clam dealer, were tried, but neither worked well. However, the Pausinas felt that with certain modifications, a conventional dredge might be suitable for fishing chowders. This would allow for an easy conversion from oyster to clam fishing. The modifications included adding weight to the dredge, lengthening the teeth, and installing a water spray system.

Exploratory efforts were concentrated in areas east of the Mississippi River, which are predominately public oyster grounds, to avoid any conflicts with private oyster lease holders. During the last week in August 1976, after the Pausinas had built and refined a workable dredge, another excursion was made. Once the proper fishing method with the modified oyster dredge was determined, several three-minute tows were made throughout Breton and Chandeleur Sounds (Figure 1). The vessel speed and direction were kept constant. Several sizeable populations of the southern quahaug *(Mercenaria campechiensis)* were observed throughout the sounds (Figure 2), primarily along the 20 ‰ isohaline as depicted by Perret et. at. 1971 (Figure 1). However, this distribution was not uniform throughout the area. There were several other molluscan species encountered, but the southern quahaug was most abundant. Because of the type of gear used, this survey was confined to clayey, non-sandy bottoms. The survey showed that the center of population was located in the southern end of Breton Sound in the vicinity of Battledore Reef (Figure 2). This is the area where exclusive fishing rights were later granted the Pausinas. However, these fishing rights are no longer in existence under clam legislation adopted in the 1979 legislative session. Sizeable clam populations have been reported west of the Mississippi River, but no sampling has been conducted west of the river. Density determinations were made in the area by towing the dredge across a known distance both with and against the wind. The tows averaged 0.1 chowder size clams per square foot, roughly one to the square yard. This is approximately the same density obtained by Gonz (1975) for Winnapoug Road, Rhode Island, in square meter plots. Fishable densities were obtained during the present study even though no small clams were taken (apparently because of the large spacing between the dredge teeth). The density amounts to roughly 60 bushels per acre if you assume you have 67 clams to the bushel (average bushel density east of the river). The clams were fairly uniform in size in these areas and averaged approximately 9.9 centimeters in length.

The Paulsinas felt they needed approximately 150,000 bushels to make the investment attractive. After calculations using several formulas for virgin stock exploration, it was felt that the managerial approach suggested for the South Carolina fisheries might be more applicable. Their approach was to fish areas on a rotational basis, assuming repopulation of a previously fished area.

The Paulsinas then applied for a 10,000-acre experimental clam lease in Breton Sound. Their application allowed the Department of Wildlife and Fisheries to look into the feasibility of leasing acreage for clam production. This amounted to approximately 600,000 bushels available by using the densities determined earlier.

There were some additional modifications to the dredge, its size increased, and the commercial harvesting of clams began in January 1977.

A total of 9,742 bushels were fished during calendar year 1977 on the permit. The fishing was done during an eight-month period, with 77 percent (7,539 bushels) being taken during the first three months. These first three months were periods of exceptionally harsh winter days for this area. There were many days when there was ice on the deck. During the early part of February, the bottom temperature was down to 2°C. and it was difficult to locate the clams. The remaining five months were only fished occasionally. Table 1 is a breakdown of the harvesting results.

Of the four zones in the lease, Zone 3 was the most productive, with 4,461.5 bushels. The catch per hour also increased in this zone during the later months. Zone 2 had no production, apparently because of the bottom type. There were several days when inclimate weather prohibited fishing within the permitted area, and for three days, fishing occurred outside the permitted area closer to shore, with a resulting harvest of approximately 450 bushels from this area.
There were several days when inclimate weather prohibited fishing within the permitted area, and for three days, fishing occurred outside the permitted area closer to shore, with a resulting harvest of approximately 450 bushels from this area.

Additional exploratory fishing was undertaken in 1978 to discover the area and extent of the resource in Breton and Chandeleur Sounds. The floods of 1973 had severely affected molluscan populations in this area (Dugas and Perret 1975). An effort was made to establish the areas of repopulation in Breton and Chandeleur Sounds. Several small clams (average size 2.7 cm) were located with a dredge designed to catch the smaller size. According to growth rates given by Monzel (1961), these should be approximately one year old. Some gear modifications are presently being undertaken to take smaller clams for commercial sale.

The size of the clams harvested ranged from 6.0 cm to 13.55 cm. Because of the majority of the clams commercially harvested were at least 11.0 cm, there were very few below the chowder class. Using growth data provided by Menzel (1961) and Saloman and Taylor (1968), the average size *Mercenaria* should be approximately 3 years old. The largest clam was 13.55 cm and 6 years old according to the Saloman and Taylor growth rate curve. The majority of the clams were in the chowder range with very few cherrystones. Because of the faster growth rate that occurs in Louisiana waters compared to those of the more northern states, it is difficult to find cherrystones.

OUTLOOK

At this time there is a significant and harvestable population of chowder size *M. campechiensis* east of the Mississippi River. The problem is the same as in

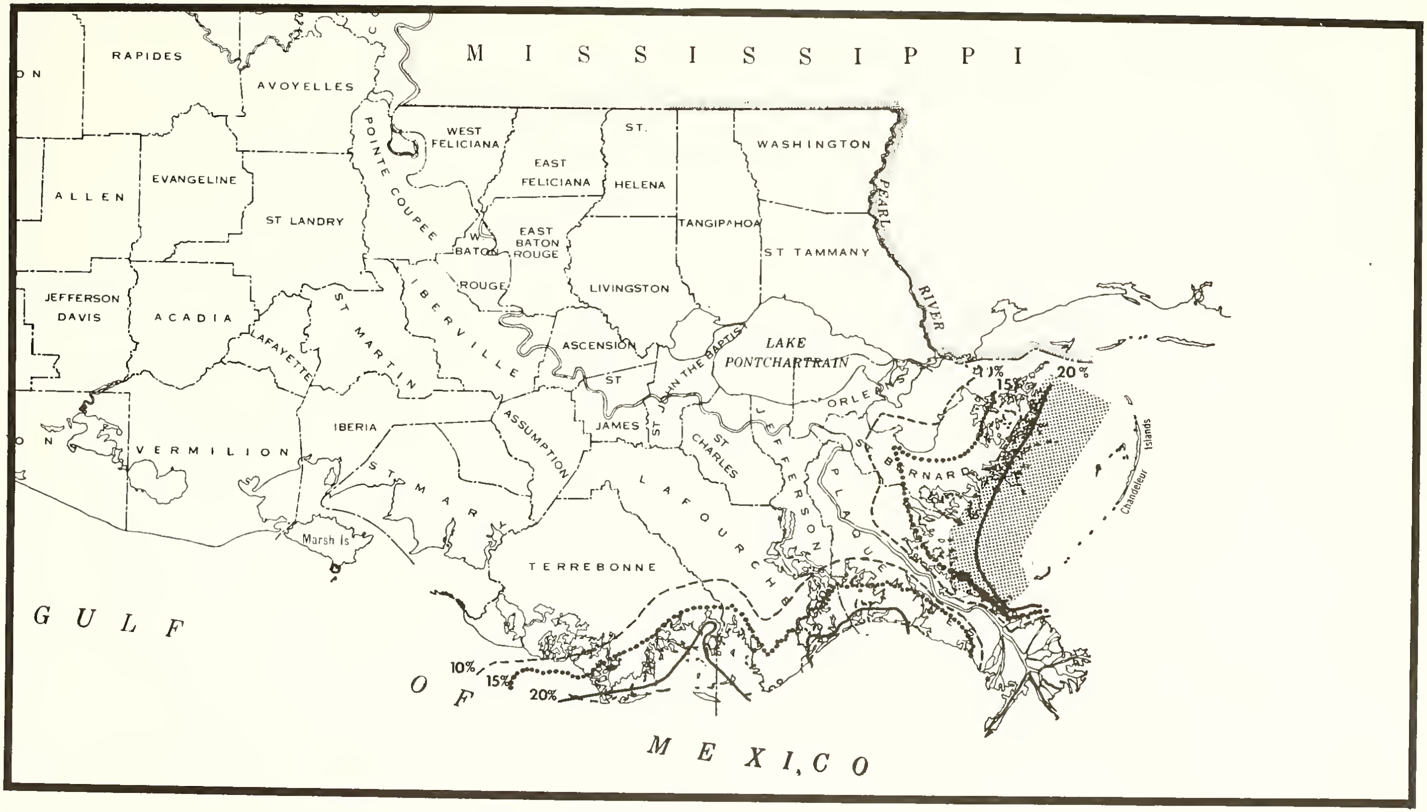

Figure 1. Isohalines as depicted by Perret, et al., (1971).

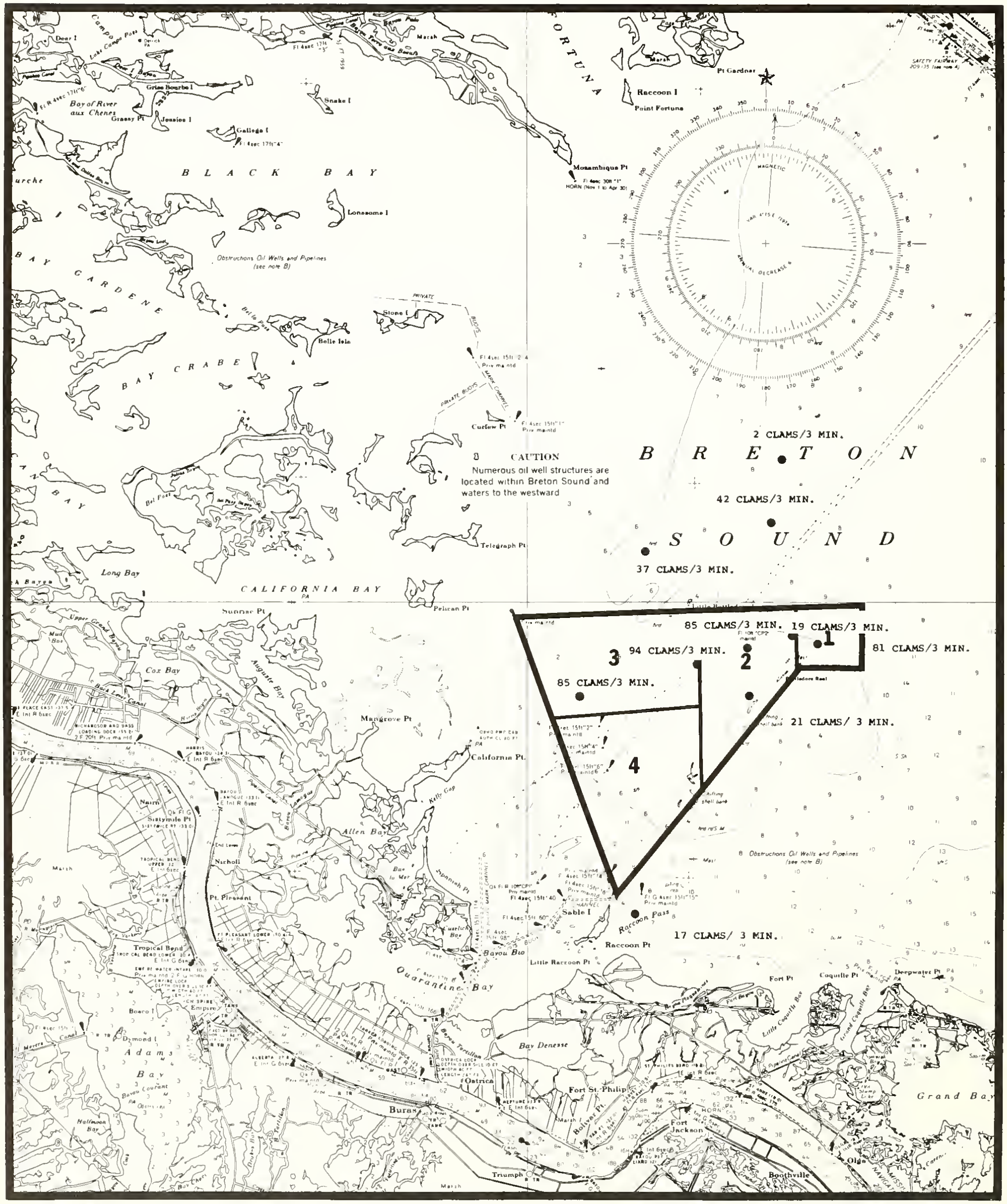

Figure 2. Figure showing various clam densities in Breton Sound with a map of the Louisiana lease.

Table 1
Clam Harvesting Results by Month and by Zones

Months	Total Catch (Bushels)	Catch per Zone		Days Fished	Bushel Per Hour
Jan.	2,048	1,475.0	1	13	26.1
		0	2		
		298.5	3		
		293.5	4		
Feb.	3,287	392.0	1	20	22
		0	2		
		1,974.0	3		
		92.0	4		
Mar.	2,204	842.0	1	14	23.2
		0	2		
		0	3		
		1,266.0	4		
Apr.	0				
May	0				
June	105	0	1	2	13.1
		0	2		
		0	3		
		105.0	4		
July	1,369	0	1	9	24.4
		0	2		
		1,369.0	3		
			4		
Aug.	829	0	1	5	30.7
		0	2		
		829.0	3		
		0			

virtually all other areas with hard clam supplies; there is no real demand for the larger quahogs. The market is oriented toward the little necks and cherrystones. There appears to be a limited supply of the smaller sizes of the species either because of a lack of a set or the fact the areas are saturated with the larger members of the population. In addition, because of the growth rate in southern waters (Menzel, 1961), only one year is required for *M. campechiensis* to grow the 1 inch from 2 to 3 inches, whereas it takes a considerably longer time for the northern variety to grow through the same size range. Thus the northern variety is available to the harvester as a cherrystone for a longer time.

During the survey a significant effort was made, and much fishing knowledge was obtained. However, a market for this size clam is lacking.

FUTURE RESEARCH AND MONITORING

Additional research is needed to generate the information required to formulate managerial procedures. To determine the standing crop of an area, five-acre plots should be set aside and throughly fished. This would give some idea of the yield that can be expected. In addition, an effort should be made annually (around March) to inventory the stock along Louisiana's coast. The inventory should include an effort to capture the young. There should be both growth rate studies and an effort to determine both natural and fishing moralities.

The technology for hatchery production of clams should be developed, because this would probably be the future for littleneck and cherrystone production.

MANAGERIAL RECOMMENDATIONS

This section contains suggestions and recommendations that could be used as guides in formulating legislature to regulate a commercial clamming industry should one develop.

A decision should be made whether to have public clamming grounds, private grounds, or a combination of both. The results of this initial investigation suggest that the grounds should be public because a leased area is too confining and permanent when dealing with littlenecks and cherrystones with erratic sets and with environmental fluctuations. Leasing might be plausible if a chowder market develops. If the grounds are to remain public, the following section should be considered. Should the grounds be placed under private control, the Leasing Section section that follows should be considered.

Public Grounds

This section offers management suggestions should the Department choose to maintain all of the waterbottoms as public fishing grounds and not to lease any areas to private individuals.

Area: All clamming grounds should be outside a "line of demarcation" of productive oyster areas, especially the "oyster seed grounds." The line of demarcation would be determined by a committee and should not be permanent. Flexibility would allow for long-term environmental changes.

Clamming Season: Persons, firms, or corporations should be allowed to take clams from public grounds from January 1 through August 31. Any grounds under private control could be fished at the owners' discretion. Should a zone rotation concept be adopted, there would be no need for seasons. The concept would allow each area a three year rest. The Commission could close or open any of the waters to clamming should biological conditions necessitate it.

Size: No clams one inch or less should be taken for shucking or for resale. Clams should be culled by the catcher when taken, and all clams one inch or less should be returned immediately to suitable bottoms. Tolerance for not more than 10% of any catch should be allowed. Mechanical harvesters must be approved and licensed by the Department prior to use.

Data Keeping Requirements: Every person licensed to catch, land or deal in clams would be required to provide information on the species, number, and weight, along with any additional information pertinent to managing the resource, in the manner prescribed and on forms provided by the state agencies. The licensee should submit the forms no later than 30 days after the close of each calendar month to the Seafood Division of the Wildlife and Fisheries Department. These requirements would pertain to both fishermen and dealers. Because the Department would have the right to close any and all waters to clamming and to impose quotas (even on private leases), an indication would be needed of the areas being overfished. A researcher could look at catch per effort and size makeup and if there were cause for alarm, he could discuss the problem with the fishermen, or impose quotas, or close the area.

Dredging Period: Dredging for clams should be allowed during both day and night, because there is a biological rhythm associated with clams. However, nighttime dredging would present an enforcement problem, because oyster dredging at night is not permitted.

Possessing Oysters While Taking Clams: It should be unlawful for clam fishermen to have any oysters in their possession while catching clams during the season when it is unlawful to take or catch oysters from the public oyster grounds. This prohibition should also apply to leases located on "Oyster Seed Ground" areas. Possibly a distinction should be made between oyster seed grounds and clam grounds.

Grassbeds: Clams should not be taken from any established bed of aquatic vegetation by any method other than by hand tongs, by hand rakes, or by hand.

Licenses: Anyone using tongs, rakes, or their hands to gather clams must have a valid clam harvesting license. A daily take of two bushels per boat would be allowed as recreational catch. Various licenses and fees could be required for commercial clamming. All fishermen and dealers should be required to obtain a permit to partake in the clam industry. Should any established regulations be violated, the Department or its agents could revoke the permit. The annual fee could be $100.00. A license should also be required on implements used to harvest clams from waterbottoms. A $100.00 fee could be imposed on each implement certified by the Department prior to licensing. A license fee for hand tongs could be $25.00.

License Revokation: The license of any person found to be operating a harvesting implement in violation of any of the clamming regulations should be subject to immediate suspension by any inspector. The boat operator should surrender the license upon request. A suspension should continue in force until a hearing before the Department, and the hearing should occur within 40 days of the suspension. The Department should determine whether to revoke or to reinstate the license.

License Display: Harvesting licenses should be attached to the port side of boat or vessel cabins, or on the port side of the bow for boats with no cabin, and should be in plain sight of Department patrolling vessels.

The name or number of each vessel, boat, or dredging apparatus engaged in harvesting clams should be displayed at all times. They should be painted on the roof of the cabin or on any surface easily visible from the air. To ensure visibility, the letters should be at least eight inches high, of an appropriate width, and prefaced with the letter *C*.

Quahuag Shells: All quahaug shell are the property of the State and should be returned under Department supervision to the waters. If desired, a severance tax of $1.00 per cubic yard of shells could be exacted.

Leasing System

Clam Leases: Under R.S. 56:421, the State of Louisiana maintains ownership and control of the State's waterbottoms. All grounds in water with a depth of 3 ft. mean low Gulf, or more, could be leased from the State for cultivating clams. The entire coastal area could be gridded into 3-mile squares (5,760 acres), and these tracts could be leased by sealed bids to the highest bidders. Prior to bidding, prospective lessees should be certified by a board to be capable of harvesting and selling clams. The leasing board could consist of: (1) assistant secretary of Department of Wildlife and Fisheries; (2) Chief, Seafood Division of Wildlife and Fisheries; (3) one commercial fisherman, and (4) one dealer. The Secretary could have the deciding vote. The two industry representatives could be selected by their peers (possibly in a meeting of the Oyster Dealers and Growers Association).

Bidding: Each bidder would be bidding on the annual rental rate to be paid to the Department for the exclusive rights to fish clams. Any resident of Louisiana or any corporation consisting of at least two Louisiana residents would be permitted to bid.

The Secretary of the Louisiana Department of Wildlife and Fisheries would lease to the highest certified bidder.

All bids, upon receipt, would be kept in the Department's safe to be opened by the Secretary, or his authorized representative, at the location, time, and date indicated in the legal notice for bidders.

A check for one year's rental fee, payable to the Secretary of the Louisiana Department of Wildlife and Fisheries, should accompany each bid.

The Secretary should return the following to unsuccessful bidders: (1) the survey fee (the estimated cost to the Department for surveying the lease), and (2) the check for the one-year rental fee.

The successful bidder would pay the cost of: (1) the one-year rental fee (bid) and (2) the survey fee.

All buoys, buoy weights, and chains used to survey the lease must be furnished by the successful bidder (who becomes the lessee).

The Department would establish a minimum bid price for each grid to be offered for lease.

Number of Leases: No person or corporation could own or control more than 10 tracts at one time.

Clam Leases on Leased Oyster Grounds: All clam leases that have oyster leases contained within the tract will be subservient to the rights of the oyster owners.

Clam leases located on "Oyster Seed Ground" or "Oyster Seed Ground Reservations" are subservient to the rights of fishermen seeking oysters.

Miscellaneous Suggestions:

The Department could revoke a lease whenever there is evidence that the lease is not under effective cultivation or that the lease is not being maintained in accordance with the law.

Should water or bottom conditions preclude successful clam cultivation, lesses could apply to the Department for suspension of the annual rental fee until conditions again become suitable.

The tracts would be leased for a 5-year period, and the current lessee would have the right to renew at the original bid price.

The Department would settle all boundary disputes between lessees of clam tracts, and its decision could be subject to any court with jurisdiction.

All leases would be inheritable and transferrable, but no ownership change would be valid until the Department was notified.

All lessees, packers, canners, and dealers should report under oath to the Department by the last day of each month the amount of clams handled the previous month. Failure of the lessee to make such a report would constitute grounds for revoking the lease. Failure of a lessee to pay for the lease on or before each January 31, without demand or placing into default, would cancel the lease. The lessee would thereby forfeit all works, improvements, betterments, and clams on the leased waterbottoms to the Department. The Department could enter the tracts and take possession thereof.

The Department would have the right to forgive ground rent on claim leases in any area declared a disaster area for clam culture. A disaster area could be declared when any natural or man-made occurrence precludes satisfactory culture of clams in the area.

No implements that would cause irreparable damage to the waterbottom should be used.

Lease areas would initially be indicated to successful bidders, but it would be each lessee's responsibility to mark and maintain markers on said leases and to use modern navigation means to remain within the boundaries of the lease.

All regulations that pertain to the removal of oysters from leased areas (RS 56:439) would also apply to clam leases. All fishermen operating on someone else's lease must have written approval aboard the operating vessel.

When a Department survey is made, the Department would mark the lease. All prospective bidders could survey the lease themselves.

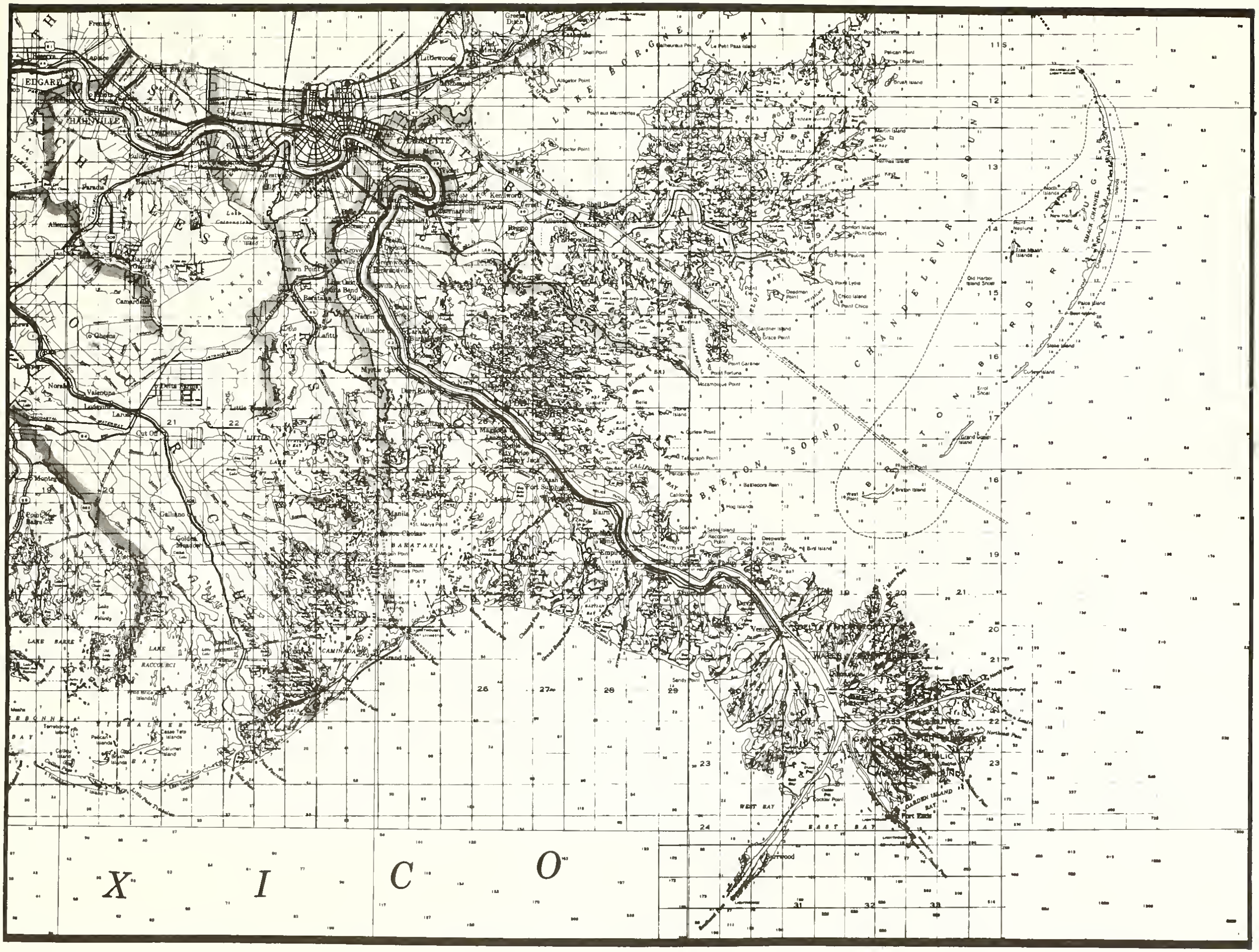

Figure 4. Three mile grids for bidding purposes.

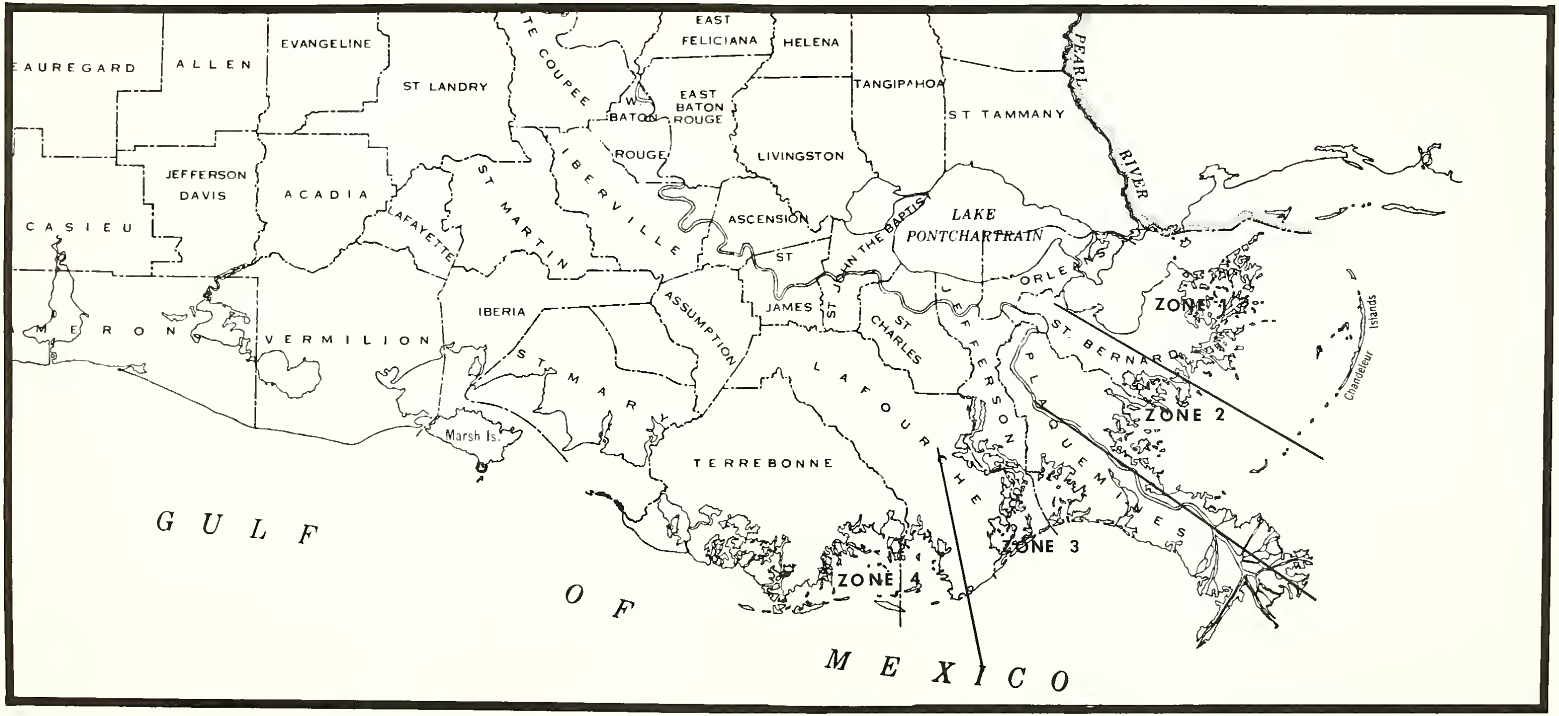

Figure 3. Possible zone breakdown in coastal Louisiana.

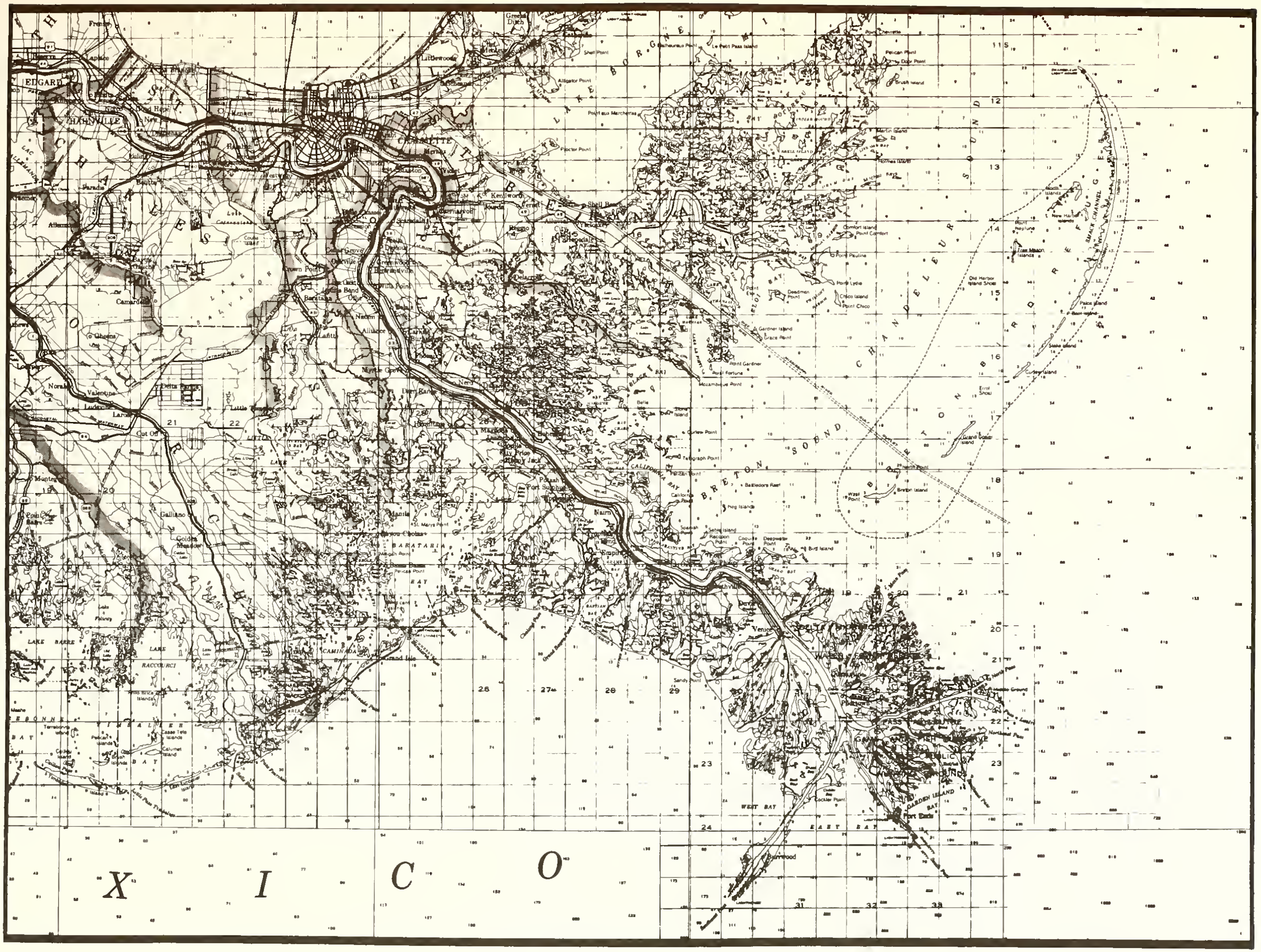

Figure 4. Three mile grids for bidding purposes.

Two potentially controversial options for clam areas are "limited entry" and "quotas." Although current data on fishing pressure are insufficient, both options should be considered.

The concept of limited entry is controversial; however, if administered properly, it could prove to be the most sound managerially. The following suggestions assume limited entry:

Except with written permission of the Secretary of the Department, no person should be permitted to take for sale, disposal, gain, or reward any clams. A person permitted to take clams should not take or attempt to take clams from any area other than the one for which his authorization applies.

The Secretary of the Department (or his authorized representative) must issue all permits for clamming, and all permits must be in the proper form and contain the number and date of authorization.

All permits to take clams may be subject to any conditions, restrictions, or limitations on seasons, zones, methods of fishing, or equipment used that are made by the Department.

For prosecution, any condition, restriction, or limitation, by whatever name described, specified, or referred to by an authorization, should be construed as a condition upon the permit to which the authorization relates.

An application for a permit to take clams should be made in writing to the Secretary or to a review board.

The permit should be good for a specified period.

The Department should establish the maximum number of entry permits compatible with maintaining an economically healthy fishery. The Department should be able to increase or decrease the permitted number of entry permits should it become necessary for biological or economic reasons. The Department should maintain a buy back program using funds derived from permit fees. The program would enable the Department to buy back permits should a reduction of permits be necessary.

Quota Periods: Should a quota system be established, the system could be modeled after the East Coast Plan.

Industry meat yield data indicate a reduced yield from late summer to early winter. The annual quota, therefore, should be divided into quarters, from the beginning of the calendar year. After the required reports indicate the quarterly quota has been reached, harvesting should be suspended until the beginning of the next quarter.

The Department should publish in the official State Register and in newspapers of general distribution in the affected areas the total allowable catch (annual quota) for the following year no later than October 1 of the year preceeding the fishing year.

The Department, or a committee thereof, should establish the quota. In addition to announcing the quota in the State Register and newspapers, the information should be mailed to all licensed clam fishers and general industry members so that the information is received no less than 30 days before the beginning of the quota year.

Because natural and man-made changes occur constantly, regulation of the industry must itself be subject to change if and when the need arises.

A Preliminary Tagging Study on the Red Drum *(Sciaenops ocellata)* in Quarter-Acre Ponds

by

STEPHEN HEIN and JOSEPH SHEPARD

Abstract

Tagging studies on red drum *(Sciaenops ocellata)* in quarter-acre brackish water bonds were carried out for 100-to-154-day periods. Fish were divided into two groups: those two pounds and under, and those over two pounds. Each group was treated separately. Five tags were used: Floy anchor, Petersen disk, self-piercing monel metal tags, Carlin dangler, and the polyethylene streamer.

The Floy anchor tag proved to be the best tag used in this study although the authors do not believe it would be acceptable over an extended period of time.

Introduction

Numerous tagging studies have been completed using a variety of tags and methods of application. Andrews (1972) marked cyprinids, as did Duncan et al. (1968), with fingerling salmonids using fluorescent pigments. Kelly (1967) marked freshwater and marine fish with injected dyes. Tebo (1957) marked bass with spaghetti ties. Everhart et al. (1960) used a barb-tag on 6 to 9 inch eastern brook trout *(Salvelinus fontinalis)*. Yamashita et al. (1958) investigated an all-plastic, dart-type tag. Dell (1968) applied internal anchor tags on rainbow trout *(Salmo gairdneri)*. Lewis (1961) field tested Petersen disks, nylon streamers, and jaw rings on striped bass *(Morone saxatilis)*. Davis (1959) field tested Petersen disks, streamer and spaghetti tags on striped bass. Vladykov (1957) compared cattle ear tags, ring-shaped strap tags, split ring, and plate tags. Jensen (1967) studied the effects of tagging on the growth of cod. Clancy (1963) studied the effect of tagging with Petersen disk tags on the swimming ability of *Salmo gairdneri* in an experimental flume. Many other studies have been completed on several species. Results found by different authors indicate that although a tag might be efficient for specific purposes such as short or long-term studies, tag retention, or easy recognition of tags, the tag may not meet the specific needs of studies dealing with other species under varying conditions. Rounsefell et al. (1945) suggest holding experiments, field trials, or both, to determine the most efficient tag for a specific purpose. They also pointed out that methods that have been successful with some species have been used on other species without adequate testing. Preliminary tag durability and retention experiments for the red drum *(Sciaenops ocellata)* are necessary to determine the most efficient tag for future growth and movement studies.

MATERIALS AND METHODS

During November and December of 1977, approximately 200 red drum *(Sciaenops ocellata)* were captured for use in a short-term tagging experiment. The primary method of capture was hook and line, but other methods were also employed, i.e., seines, trammel, gill, and hoop nets. Following capture, the fish were transported in 125-gallon nalgene tanks to the Marine Research Laboratory on Grand Terre Island, Louisiana, where they were stocked into a quarter-acre brackish water holding pond. Five quarter-acre ponds, as described by Broom et al. (1968), were used. Pond temperatures ranged between 2.9 to 31.3°C throughout the study; salinities ranged between 11.7 and 27 ppt. The most abundant food organisms in the ponds were sheepshead minnows *(Cyprinodion variegatus)*, Gulf Killifish *(Fundulus grandis)*, blue crabs *(Callinectes sapidus)*, and grass shrimp *(Paleomonetes sp.)*.

Holding the stock in a quarter-acre pond prior to actual tagging operations allowed for initial capture and handling mortality. It also permitted quick observation of specimens that were emaciated or stressed by scale loss, infections, or fin damage. These fish were excluded from the study. There were two distinct size groups of fish. Small fish were designated as those fish weighing two pounds or less and large fish, as weighing over two pounds. To ascertain whether there was any difference in retention between small and large fish, they were treated separately.

The water level in the holding pond was dropped to an approximate two-foot level, and a 100 foot x 6 foot x 1 foot mesh bar seine was pulled the length of the pond to concentrate the fish. They were then dipped out of the net and placed into a holding net in an adjacent pond. Two fish at a time were removed from the holding net and placed into a 125-gallon tank containing Quinaldine, as an anesthetic, at a rate of one milliliter per gallon of water. One fish was then removed from the tank and was placed on a table, where two taggers each applied one tag to the fish. Each tag method was paired with one tag from each of the other methods, producing 21 different tag combinations. For the small fish group, each of the five ponds contained 21 fish, permitting six replications of each tag method per pond. Because of the smaller amount of fish in the large-fish group, 21 fish were divided into two ponds having six replications per two ponds. Four ponds were treated in this manner. Following tag application, the fish was placed in a holding net in the pond into which it would be stocked. When the fish appeared fully recovered and able to maintain its balance, it was released from the net, and the tag combination was recorded. The five tag types and seven methods of application are described below.

I. Floy tag — The specific tag used in this study is described in the Floy Tag Catalog as the FD-68B anchor tag having No. 20 tube monofilament inserted through it and secured. Overall length is 3¾ inches, consisting of 3 inches of gray vinyl tubing containing the legend, and ¾ of 1 inch bare monofilament. The base of the shaft is a T-bar design with a ⅜ inch bar. A Dennison Mark II tagging gun with 7/16 inch insert was used with a heavy-duty (0.090″ OD) needle. Needle insertion was on the left side of the fish below the posterior portion of the soft dorsal fin at an approximate 45 degree angle. When the base of the needle was against the flesh, the handle of the tagging gun was compressed and the gun was twisted about ⅛ inch turn to "lock-in" the tag between the interneural bones of the dorsal fin. The needle was then slowly withdrawn and the handle was released. The tag was tugged lightly to be certain the tag was properly applied. A more detailed description of this type of tag and method of application is presented by Dell (1968). Tags were obtained through the Floy Tag and Manufacturing Company, Inc., Seattle, Washington.

II. Petersen Disk Tag — This tag consists of two circular, rigid, vinylite disks with centered 0.039 inch holes through which a 3-inch long nickel pin (0.037 inch diameter) was passed. Two sizes of disks were used to accomodate the two groups of fish: an 8 mm diameter disk was used on the small group and a 14 mm diameter disk was used on the large group. To remove one step from the tagging procedure, the pins were prepared prior to tagging by placing one disk on the pin. Two sites were chosen for tag attachments. One scale was removed below the posterior portion of the dorsal fin where the pin was pushed through the body, after which the second disk was applied snugly against the opposite side of the fish and the wire pin was cut and crimped simultaneously with a special pair of pliers. Needle nose pliers were used to hold the pin near the point to prevent bending when it was forced through the opercular bone from the inside to the outside. Following placement of the second disk, the pin was cut and crimped as in the afore-mentioned manner. Disks were obtained from Howitt Plastics Company in Mollala, Oregon. Pins were obtained from the Noestring Pin Ticket Company, Inc., New York, New York.

III. Self-Piercing Monel Metal Tags — The two sizes of tags used were No. 3 (9/16 inch bar length) for the small group and No. 4 (13/16 inch bar length) for the large group. Each size tag requires its own applicator. When the tag is closed with the special pliers, the point end interlocks into an opening on the bar end of the tag. The two sites of tag attachment were on the side of the lower jaw (maxilla) and on the middle of the barchiostegals. Bands and pliers were obtained through the National Band and Tag Company, Newport, Kentucky.

IV. Carlin Dangler — This tag consists of a 3/16 inch x 9/16 inch x 1 mm oblong tag for the small fish group and a ¼ inch x ¾ inch x 1 mm tag for the large group. A 0.050 inch hole is located on one end. The tag is rigid vinylite and laminated to retard fading of the legend and to bring the tag to the desired thickness. The wire is "dead soft" stainless (monel) wire, 0.012 inch thick (personal communication, John Howitt). The tag was applied by puncturing the flesh below the lower jaw on the left side through which one end of the wire was passed. The two ends were then twisted together, and the loose ends were clipped. These tags were obtained through the Howitt Plastics Company in Mollola, Oregon.

V. Polyethylene Streamer — A 3/16 inch x 9/16 inch x 1 mm tag was used on smaller fish and a ¼ inch x ¾ inch x 1 mm tag was used on the larger fish group. Polyethylene line was chosen over polypropylene because of the ease in tying. The oblong tags are rigid vinylite and had a 0.050 inch diameter hole on one end. Prior to tagging, a tag was tied to the polyethylene line, and one end was passed through the eye of a 3-inch curved canvas needle. The needle was then passed through the fish below and between the spinous and soft dorsal fin. A knot was used to join the two ends of the line and the excess was trimmed. Line and tags were obtained through the Howitt Plastics Company in Mollala, Oregon.

RESULTS AND DISCUSSION

A comparison of tag retention for small and large fish for 100 days is presented in Figure 1. One pond that contained both size groups of fish for the 15-day period was lost. Because this pond contained one half of all replications of some tags for the large fish, no overall percentage can be concluded for any greater length of time than 100 days. The retention percentage for large fish is listed in Table 1. Total numbers and percentages of recovered fish in the small group for three different periods and an overall retention for the entire study is also listed in Table 1. An analysis of variance was run on all tags of the small fish group for the overall period (Table 2). The "f" value obtained indicates a significant difference between the tags. A Newman-Keuls multiple range test was run to determine which tags were significant over other tags (Table 3). Results and discussion of each tag for both size group are listed below.

Floy — Tag retention was the same in both the small and large fish groups for the initial 100-day period. This tag had the highest overall percentage retention (67%) for the small group, but it was second highest for the large group (67%), exceeded only by the Streamer dorsal with 83 percent retention. It was determined that this tag was significantly better than all of the other tags except the metal operculum tag applied to the small fish group.

Application is quick, averaging 5.0 seconds, and easy in cold weather. Although there was one gross case of infection at the tag site, The majority of tag wounds had healed. The base of the tubing on several tags was brittle and beginning to split at the end of 154 days. This condition was also noted by Davis (1959) who found brittleness in soft spaghetti tags of ivy flex tubing and in hard spaghetti tags of vinylite tubing. On one recovered fish the tubing was missing, and only the monofilament anchor remained. Apparently, as the base of the tubing splits, friction increases and the tubing peels.

Nearly all of these tags had algal growth, with some extreme cases noted. Davis (1959) noted hydroid growth on some soft and hard spaghetti tags. The algae is believed to have accelerated tag loss, because several specimens were found to have the tag pulled out from the interneural bones and lodged precariously in the flesh. Some wounds were associated with the worse cases.

Metal operculum — This is the metal "strap" tag described and illustrated by Rounsfell and Kask (1945). It was the third quickest tag to apply, averaging 9.3 seconds. It had the second highest overall retention in the small fish group (46%) and the third highest for the larger fish group (33%). The metal operculum was found to be significantly better than the Petersen disk applied dorsally and the streamer applied to the jaw in the small fish group. Special applicator pliers made application easy, with little apparent harm to the specimens. No fouling of these tags were observed. Those fish having lost the tag were easily identified by a tear in the fleshy part of the operculum.

Metal jaw — This is the same tag that was applied to the operculum. Application time was only 5.5 seconds, and no problems were encountered with fouling organisms. However the tag was not effective when applied to the lower jaw of the spotted seatrout for the same reasons summarized by Vladydov (1957). He found ". . . the pressure of the metal caused reabsorption of the bony tissue, and this permitted the tags to fall off in a few months." This is apparently the same process that occured with the red drum in this study. Tag retention following a 100-day period for the small fish group (33%) was nearly twice that of the large fish group (17%).

Streamer dorsal — Although this tag had the highest retention (83%) in the large fish group, the method of application was too time consuming (47.8 seconds). The greatest amount of time was used in tying the Angler's knot, also known as the single fishermen's knot, as described in Tom McNally's *Complete Book of Fishermen's Knots*. Knot tying was hampered by wet and cold weather. There would be even greater disadvantages in a boat under more adverse conditions. In contrast, the streamer for the small fish group had one of the lowest retention rates (21%).

Some algal growth was attached to the polyethylene line and the streamer after 100 days. Davis (1959) also recorded occasional hydroid growth on the streamer tags applied to striped bass in Beaufort, North Carolina.

Carlin dangler — This tag required 31.4 seconds to apply, which was the second longest application time. In several specimens the monel remained on the fish, but the tag portion was missing. The tag was among the lowest in retention for both small (8%) and large (0 recovered) fish groups.

Petersen disk — In an aquarium study with striped bass Calhoun (1953) found that Petersen disks applied under the first dorsal fin and on the caudal peduncle to be satisfactory for general use. However, Calhoun et al. (1951) found the nickle pin and the monel wire used to hold the disks to be totally unsatisfactory in saltwater fish because of corrosion. They also noted that the vinylite disks became brittle and were subject to cracking. These are also probable reasons for tag loss in this study.

Application time required averaged 19.7 seconds, which agreed with the findings of Calhoun et al. (1951) that the tag was "slow to apply." The Petersen disk applied to the operculum and below the dorsal averaged 29% and 4% respectively, for the small fish group at the end of 154 days. In the large fish group, it averaged 17% at both tag sites for 100 days.

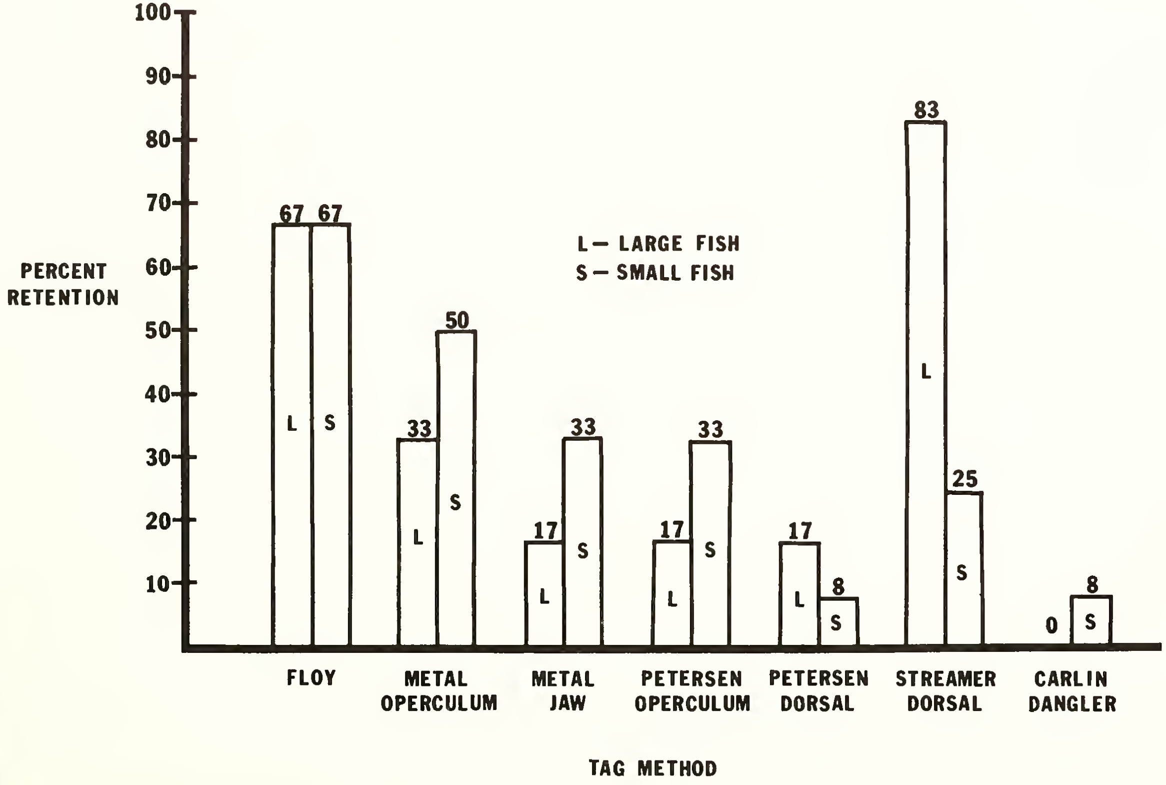

Figure 1. Percent retention for each tagging method

Table 1
Tag Retention for Small and Large Fish Groups

Small Fish Group	100 Days			127 Days			154 Days	
Tag Type	Tags	# Recovered	% Retention	# Tags	# Recovered	% Retention	# Tags	# Recovered	% Retention
Floy dorsal	12	8	67	6	4	67	6	3	50
Metal operculum	12	6	50	6	2	33	6	3	50
Metal jaw	12	4	33	6	0	0	6	0	0
Petersen operculum	12	4	33	6	3	50	6	0	0
Petersen dorsal	12	1	8	6	0	0	6	0	0
Streamer dorsal	12	3	25	6	1	17	6	1	17
Carlin dangler	12	1	8	6	0	0	6	0	0

Large Fish Group	100 Days		
Tag Types	# Tags	# Recovered	% Retention
Floy dorsal	6	4	67
Metal operculum	6	2	33
Metal jaw	6	1	17
Petersen operculum	6	1	17
Petersen dorsal	6	1	17
Streamer dorsal	6	5	83
Carlin dangler	6	0	0

	Total of all Runs on Small Fish Group		
	# Tags	# Recovered	% Retention
Floy dorsal	24	15	63
Metal operculum	24	11	46
Metal jaw	24	4	17
Petersen operculum	24	7	29
Petersen dorsal	24	1	4
Streamer dorsal	24	5	21
Carlin dangler	24	1	4

Table 2
Analysis of Variance for Significance between Tagging Methods

Source	d. f.	S.S.	M.S.	F
Treatments	6	40.36	6.72	F - obtained = 6.92
Error	21	20.50	0.97	F - required = 3.09
Total	27	60.86		$\alpha = 0.05$

Table 3
Ranked Significance between Tagging Methods

Method	Petersen Dorsal	Carlin Dangler	Metal Jaw	Streamer Dorsal	Peterson Operculum	Metal Operculum	Floy Dorsal
———	———	———	———	———	———	———	———
		———	———	———	———	———	
———	———	———	———	———	———		
———	———	———	———	———			
———	———	———	———				
———	———						

Note: Any two tag methods not underlined by the same line are significantly different ($\alpha = 0.05$)

SUMMARY

Results of pond study are summarized as follows:

Floy — The floy tag was the quickest tag to apply and had one of the highest retention rates. Although the tag appears adequate for short-term studies, the authors believe it would be unacceptable under the same conditions for an extended period of time. The primary problems associated with this tag are fouling and cracking.

Streamer dorsal — This tag showed some merit with the large fish group, but it was deemed unacceptable because of the time required for application. Some fouling was also noted.

Carlin dangler — This tag had one of the lowest overall retention rates. It was found to be totally unacceptable because of the breaking of the monel wire.

Metal operculum — This tag was unacceptable both because it had a mediocre retention rate and because the tags that remained were tearing out of the fleshy part of the operculum.

Metal jaw — Although this was one of the quickest tags to apply, Vladykov's (1957) findings best analyzed the primary problem with the tag applied to the lower jaw — reabsorption of the bony tissue caused tags to fall off. Neither of the metal tags, as used in this study, showed any fouling organisms and may have some future prospects with other species and other tag sites.

Peterson dorsal — This tag required a relatively long time to apply and was rejected primarily because of low retention, which possibly was caused by breaking of the nickle fish pins or cracking of the vinylite disks.

Peterson operculum — Results for this tag were the same as for the Petersen dorsal.

Although none of the tags tested in this study with red drum were considered acceptable for long-term studies, it is possible that each of the tags could be useful in other areas with different species under different conditions.

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Total Length-Standard and Length-Weight Regressions for Spotted Seatrout, *Cynoscion nebulosus;* Red Drum, *Sciaenops ocellata;* and Black Drum, *Pognoias cromis,* in South-central Louisiana

by
STEPHEN HEIN, CHARLES DUGAS,
and JOSEPH SHEPARD

Abstract

Standard length (SL) - total length (TL) relationships for three commercially important sciaenids were found to be SL = -3.8832 + 0.8653 TL for spotted seatrout; SL = -2.0520 + 0.8369 TL for red drum; and SL = 0.8331 TL - 8.6854 for black drum. Length-weight relationships were also computed and found to be Log W = -5.4215 + 3.1542 TL for spotted seatrout; Log W = -5.1197 + 3.0523 Log TL for red drum; and Log W = 2.9709 Log TL - 4.8176 for black drum.

Introduction

To study a particular species, it is often necessary to compare results with related works of other authors. The indiscriminate use of total length (TL) or standard length (SL) often is an obstacle to evaluation of results. To establish a means of interchanging various length measurements, total length-standard length regressions were calculated for three commercially used Sciaenids — spotted seatrout *(Cynosicion nebulosus);* Red drum *(Sciaenops ocellata);* and black drum *(Pogonias cromis)*. Total length-weight regressions were also calculated. These regressions will aid in the future determination of relative conditions for these species as compared to the conditions in other locations.

MATERIALS AND METHODS

Fish were collected in southeastern Louisiana coastal areas using several gears, i.e., trawls, cast nets, hooks and lines, hoop nets, gill nets, seines, and trammel nets, during the period of January 1, 1975, to December 31, 1978. Standard length and total length were measured to the nearest millimeter (mm). A Mettler balance was used to weigh the smaller fish, and a bench -type balance scale was used for larger fish; weight was measured to the nearest gram (g). To convert from standard length to total length, the following formula was used: SL = a + b (TL). The equation (Log W = Log a + b Log L) was used to compute the relationship of length to weight. All length measurements referred to will be in total length unless otherwise stated.

RESULTS AND DISCUSSION

Standard length-total length and length-weight relationships for spotted seatrout based on 1,208 specimens, ranging in size from 21 to 629 mm, were determined to be: SL = -3.8832 + 0.8653 TL (Figure 1) and Log W = -5.4215 + 3.1542 TL (Figure 2), respectively. The correlation coefficient (r value) for total length-standard length was 0.9946; the r value for length-weight was 0.9941.

The standard length-total length and the length-weight regression for 302 red drum ranging from 14 to 1135 mm was determined to be: SL = -2.0520 + 0.8369 TL (Figure 3) with an r value of 0.9996, and Log W = -5.1197 + 3.0523 TL (Figure 4) with an r value of 0.9987.

Welsh and Breder (1924) in Fernandina, Florida, found Log W = -1.99 + 3 Log SL for 21 red drum less than 75 cm. Boothby and Avault (1971) in Hopedale, Louisiana, found Log W = -4.42161 + 2.83234 Log TL for 349 fish, ranging from 250 to 932 mm. Theiling and Loyacano (1976), using 88 specimens from South Island, South Carolina, found Log W = -1.29596 + 2.74031 Log SL.

The standard length-total length relationship for 750 black drum was determined to be SL = 0.8331 TL -8.6854 (Figure 5), with an r value of 0.999. The fish ranged in total length from 44 to 1061 mm. The length-weight relationship was Log W = 2.9709 Log TL -4.8176 (Figure 6), with an r value of 0.989. Richards (1973) reported a length-weight relationship of Log W = 3.0655 Log FL -4.9093 for 281 black drum from the Chesapeake Bay area. Fork length rather than total length was measured; however, since black drum have a truncate tail, fork length and total length are nearly the same, and the two studies compare favorably.

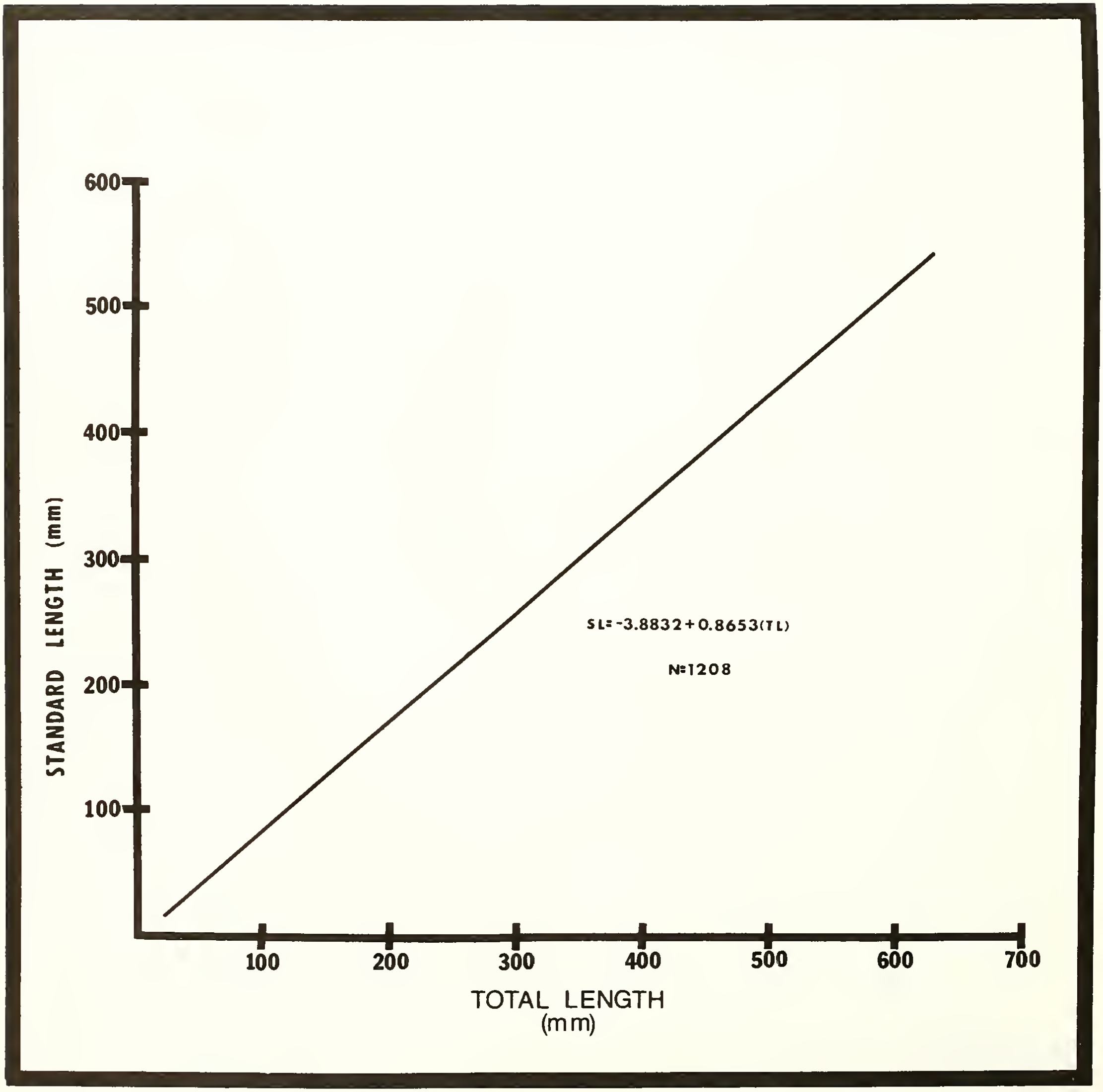

Figure 1. Standard length - total length regression for spotted seatrout *(Cynoscion nebulosus)* in southcentral Louisiana.

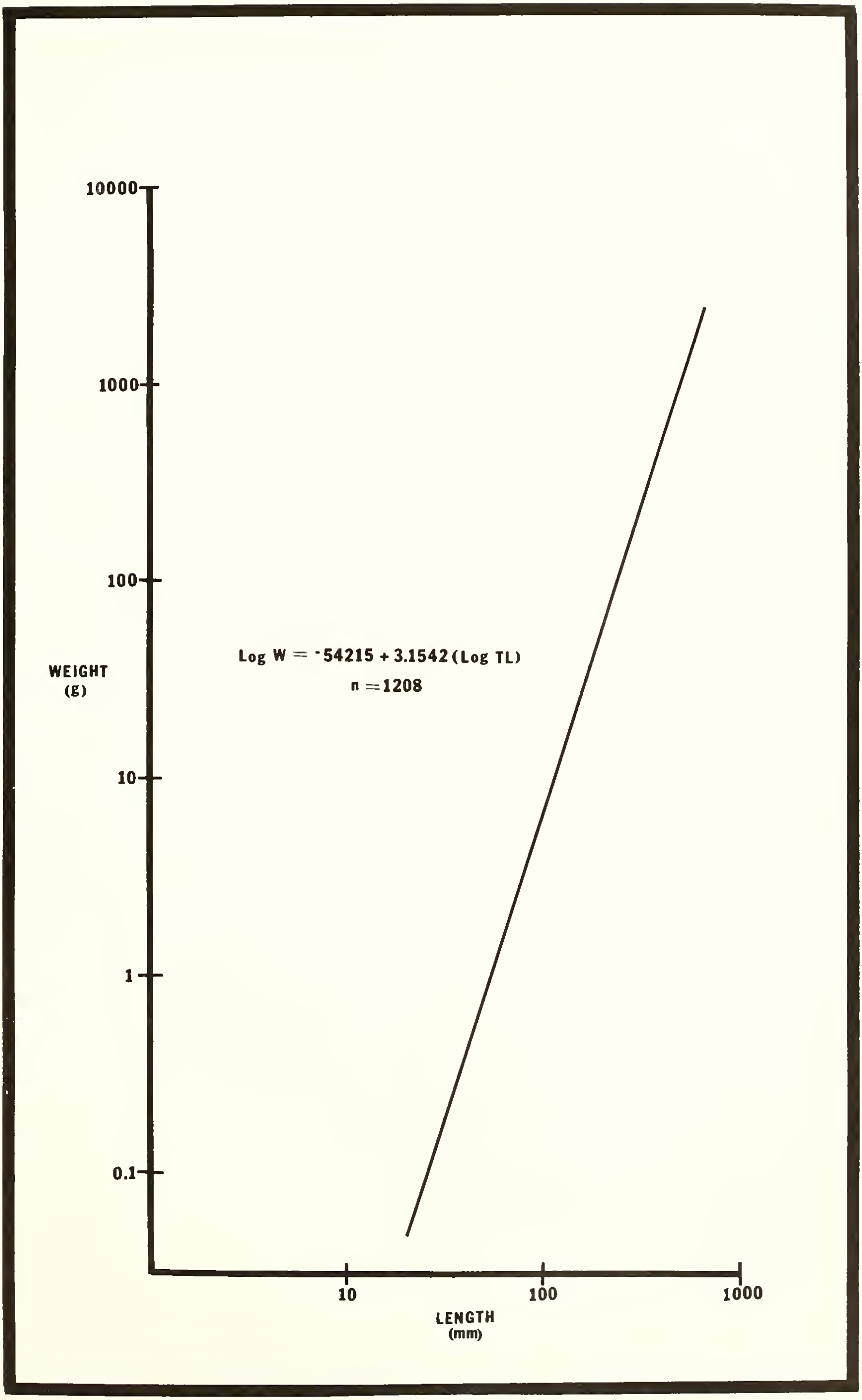

Figure 2. Length-weight regression for spotted seatrout *(Cynoscion nebulosus)* in southcentral Louisiana.

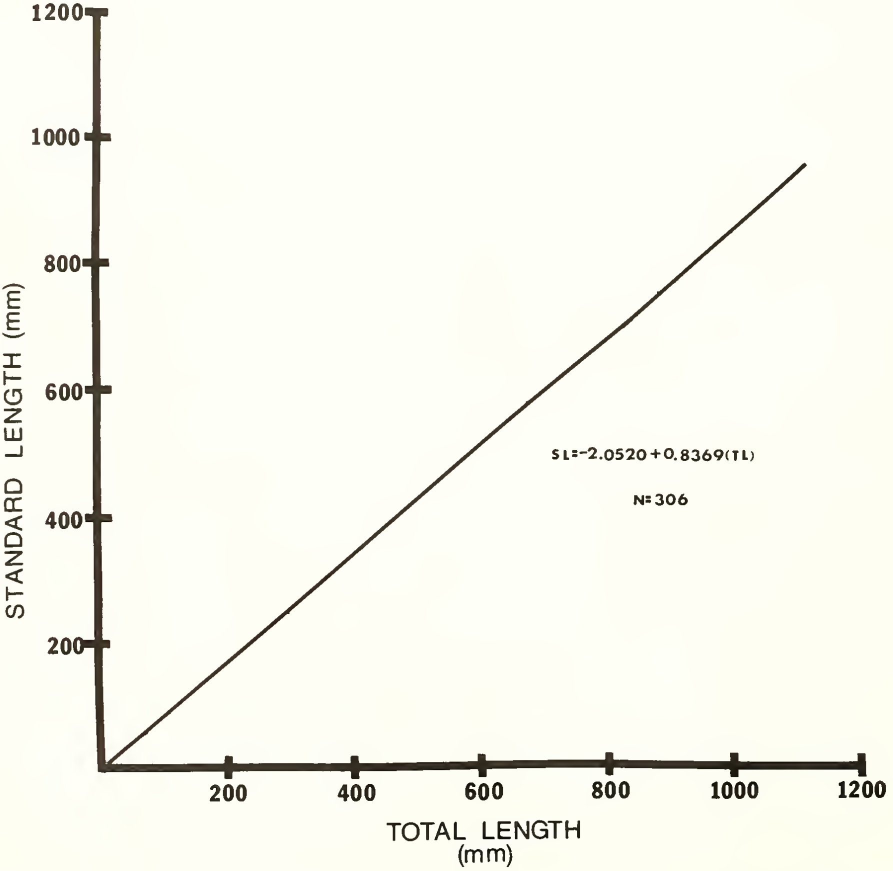

Figure 3. Standard length - total length regression for red drum *(Sciaenops ocellata)* in southcentral Louisiana.

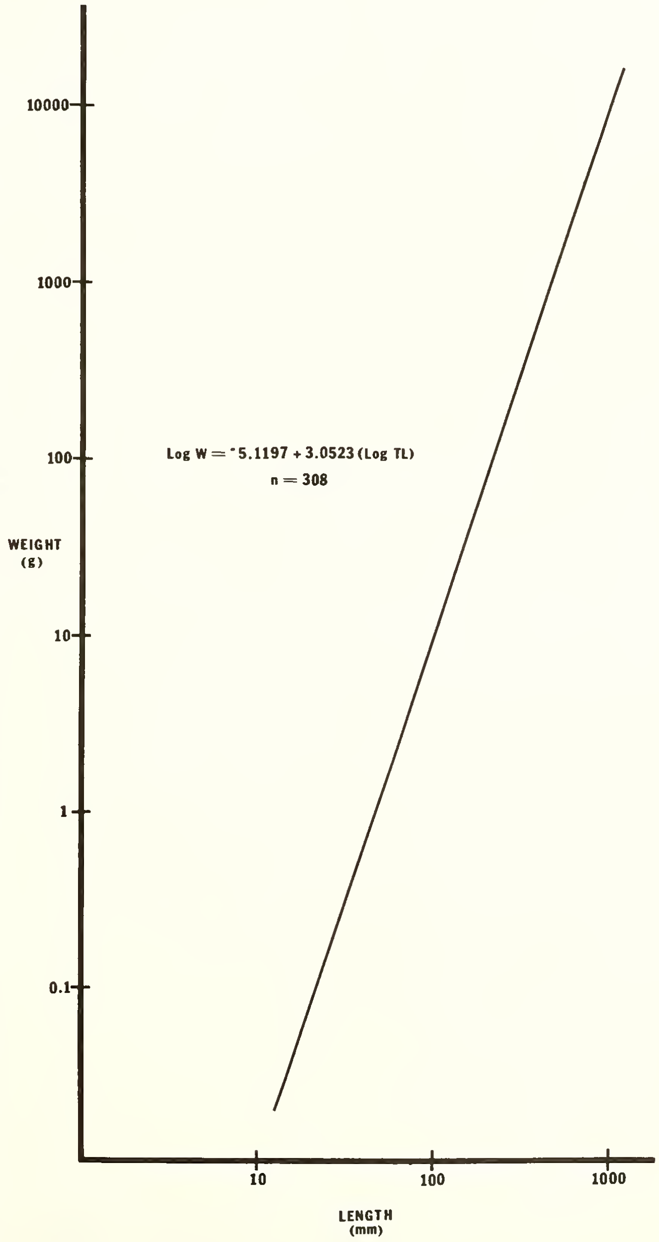

Figure 4. Length-weight regression for red drum *(Sciaenops ocellata)* in southcentral Louisiana.

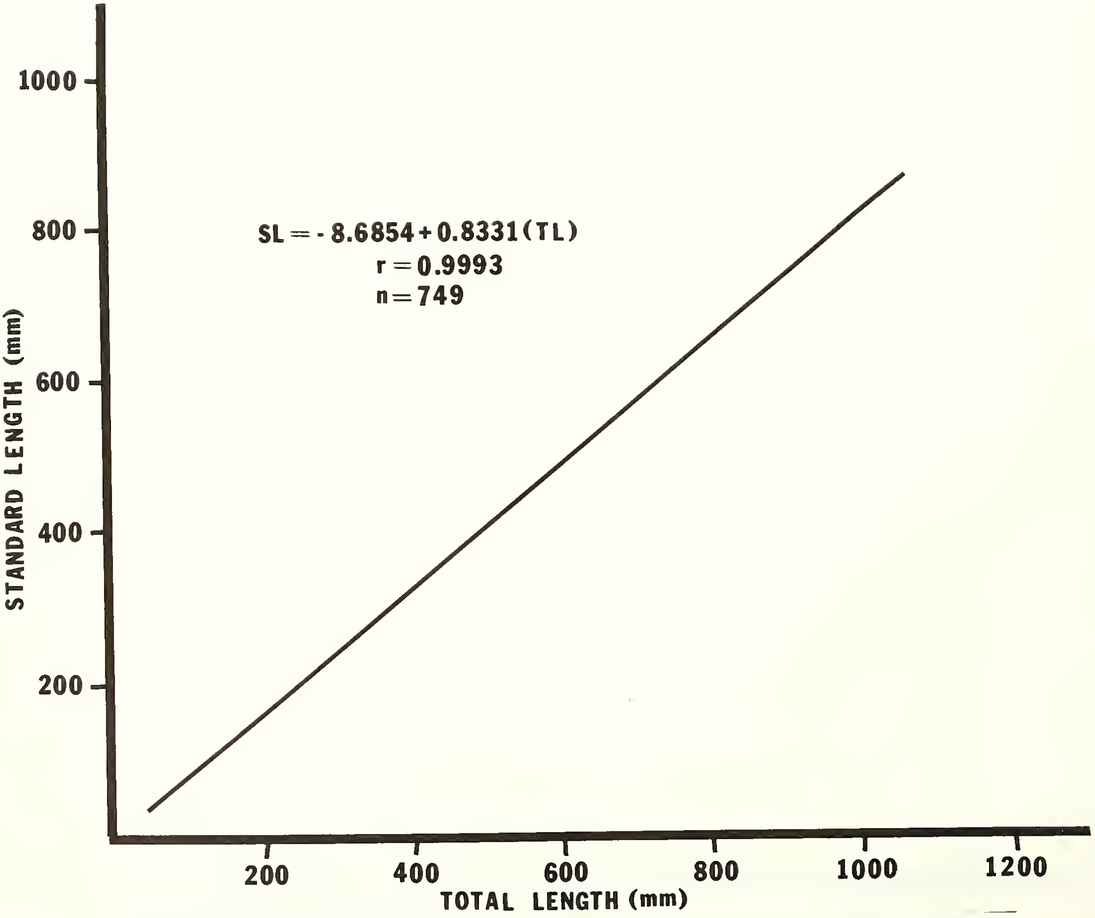

Figure 5. Standard length - total length regression for black drum *(Pogonias cromis)* in southcentral Louisiana.

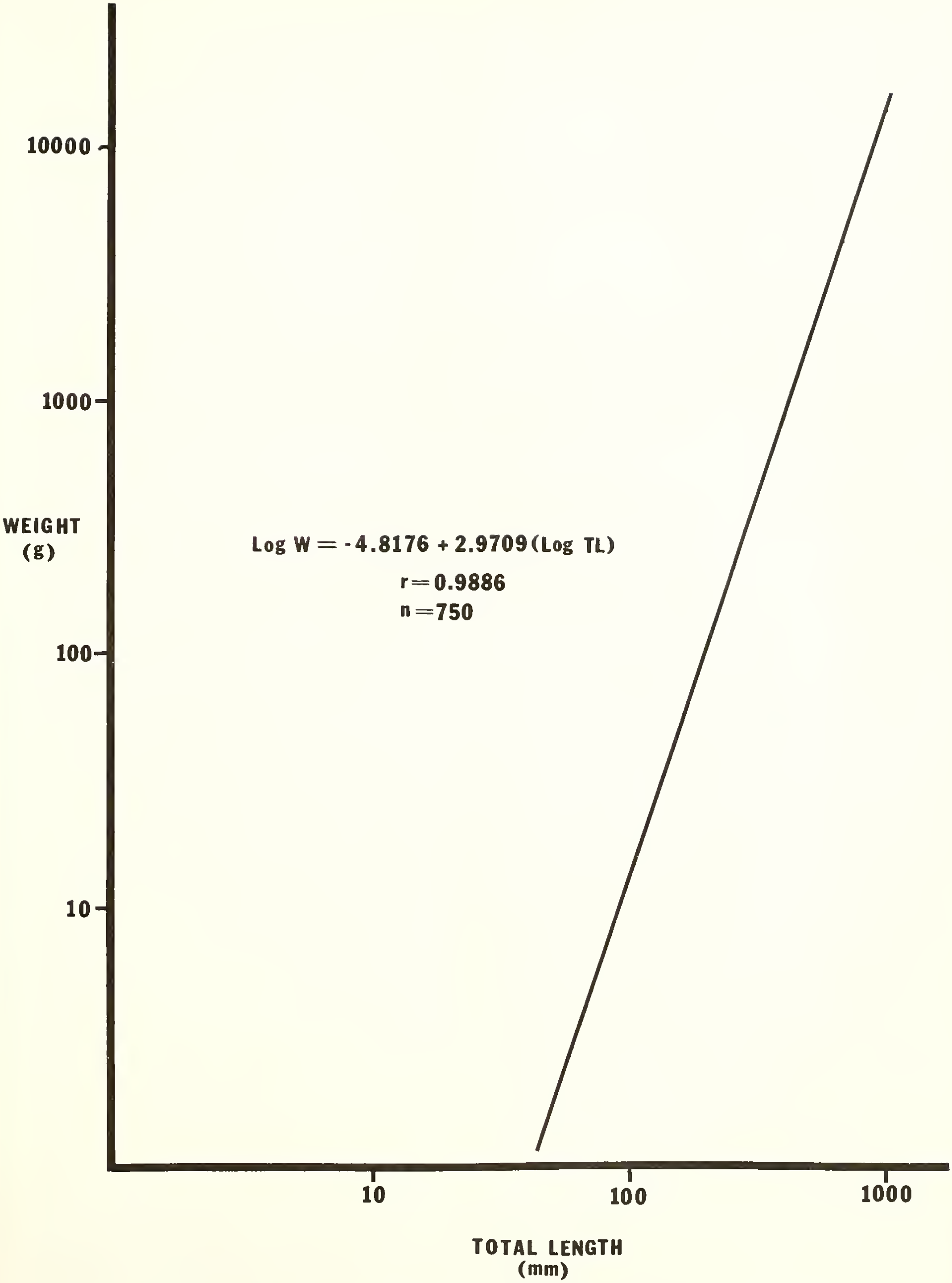

Figure 6. Length-weight regression for black drum *(Pogonias cromis)* in southcentral Louisiana.

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Size of Spotted Seatrout *(Cynoscion nebulosus)* Captured in Three and One-Quarter Inch Stretched Monofilament Gill Nets in South Louisiana

by
STEPHEN HEIN and JOSEPH SHEPARD

Abstract

Throughout an eleven month period during 1976, 767 spotted seatrout *(Cynoscion nebulosus)* were sampled from commercial fishermen who used three to three and one-quarter inch stretch mesh monofilament gill nets. Mean total length for all fish was 377 mm, with a mean weight of 544 g. Although there was overlapping of ranges of males and females, the average female was larger (391 mm, 611 g.) than the male (354 mm, 440 g.). Third-year class fish dominated the catch, with second and fourth year classes comprising the next highest groups.

Introduction

There has been much controversy over using monofilament gill nets to capture commercially important fish species along the Louisiana Gulf Coast. Of primary concern to opposing user groups is the spotted seatrout *(Cynoscion nebulosus)*. During the gill net controversy, it has become evident that there is little information on the size of fishes captured using a specific gear type (monofilament gill nets) and specific mesh sizes. Because the bulk of gill netting activity in this area centered around the three to three and one-quarter inch stretch mesh nets, this study concentrated on that size nets. Controversy over the use of gill nets is not unique to Louisiana and has arisen in all of the Gulf Coast states. There is little information on the sizes of commercially important fishes captured by these nets along the Louisiana Gulf Coast; however, some studies have been completed in Florida (Moffet 1961, Trent and Pristas 1977, Klima and Tabb 1959, and Tabb 1960). This gear has become popular because of its selectivity for a specific range of marketable fishes, its efficiency, and its relative ease in "working" over more conventional gear such as seines and trammel nets.

This study was initiated to determine the size and possible age of spotted seatrout captured by monofilament gill nets with stretch mesh sizes of 3 to 3¼ inches. Data developed will be helpful in establishing new or additional guidelines or retaining present regulations.

DESCRIPTION OF AREA

The study was conducted in coastal waters of Terrebonne, Lafourche, and Jefferson Parishes. Most of the area is composed of a saline, marsh-type environment with canals, bayous, small lakes, and bays. The remaining portion consists of sandy bottom coastal areas, islands, and island chains. Major marsh zone vegetation types, as described by Perret et al. (1971), are oyster grass, wiregrass, blackrush, and three-corner grass.

MATERIALS AND METHODS

Because commercial net fishermen were effective in capturing fish on a regular basis, samples were obtained from their catch. Thus, with the permission of the Bayou Fish Company in Leeville, Louisiana, and with the cooperation of individual fishermen, the 11-month study was initiated on February 1 and continued through December 31, 1976. Throughout the study, 767 fish were sampled. Sampling was conducted on a weekly basis, except when inclement weather prohibited fishermen from setting their nets. Incoming boats were met by biologists who randomly selected fish from the hold of the boat or immediately following unloading. Fish were slit open for sex determination, weighed on a Pennsylvania balance scale, and standard and total lengths were measured in millimeters. Nets used in this study were monofilament gill nets 1,000 to 1,200 feet long and 6 to 8 feet deep. Depth of the net varied with the fishermen's preference and the area fished. Twine size was No. 6 (0.62 mm diameter) monofilament, and nets were hung on a one-half basis; that is, one foot of cork and lead line was hung for every 24 inches of stretched mesh. Nets were set by using skiffs that averaged 20 feet long and that were powered by outboard motors that were usually located in the front center of the boat. Usually each skiff was manned with a crew of two, and nets were "fished" day and night. There were two primary methods by which the nets were fished: the runaround gill net and the drag down gill net. The runaround gill net was described briefly by Siebenaler (1955): "The method of fishing is characterized by the fact that the nets are usually set in a closed near-circle or oblong pattern, and are picked up after a relatively short period of time." In addition, nets were sometimes set in a straight line, a semicircle, or a horseshoe pattern. After setting the drag down gill net, it would be dragged across the bottom toward the boat.

RESULTS AND DISCUSSION

The mean total length for all fish was 377 mm (14.8 inches), with a mean weight of 544 g (1.2 lb) (Figure 1). On the average, females were larger than males (Figure 2) with a total length of 391 mm (15.4 inches) and a total weight of 611 g (1.3 lbs) for the females as compared to a total length of 354 mm (13.9 inches) and total weight of 440 g (1.0 lb) for males. Results of similar studies by other authors are listed in Table 1. The mean total length found in this study compared favorably with findings in a study of St. Andrew Bay, Florida, by Trent and Pristas (1977). Using the same size mesh nets (3.00-3.25 inch), Trent and Pristas found a mean length of 373 mm. Klima and Tabb (1959), using slightly smaller mesh nets (2.75 to 3.25 inch), calculated a smaller mean length of 358 mm; Tabb (1960), using 3.13 inch mesh nets, found a higher mean length of 393 mm.

Overall ranges of total lengths for males and females combined and for males and females separately are given in Figures 1, and 2 respectively. Using scale determination to age the trout caught in 3 to 3¼ inch stretch mesh nets, Klima and Tabb (1959) found that fish caught in gill nets were from two to seven years old, with three and four year olds dominating the catch. However, Matlock et al. (1977) stated that "the 7.6 cm stretched mesh gill nets do not catch one or two year old spotted seatrout and catch very few three year old fish." Using the same mesh sizes of 3 to 3¼ inch, the present study shows results similar to those found by Trent and Prestas (1977) (Table 1). The size of fishes captured in the net varied with the way they were caught, i.e., gilled, wedged, or tangled, as reported by Hamley (1975) and described by Baranov (1914). Tangling by teeth, fins, and bony projections contribute to the extremes in the ranges of fishes captured. The range would also vary according to an increase or decrease in girth caused by conditions, sexual maturity, ripeness, or food in the gut. This has been suggested by several authors: Tester 1935, Farran 1936, Strzyzewski 1964, and others.

Year classes determined by several workers are listed in Table 2. Using Tabb's (1961) estimate of year class, results of this study indicate that three-year-old fish (377 mm) dominate the catch over all year classes. Second and fourth year classes made up the next largest groups of fish.

Throughout the study, females consistently outnumbered males in the samples. After selecting the desired number of females from the sample, it was sometimes necessary to sex several hundred additional fish to obtain a small number (5 to 20) of males. This can be attributed to several factors:

1. Predominance of year classes. Tabb (1961) lists a percentage of females to each year class from the Indian River area of Florida. Year Class III is composed of 68% female; Class IV is composed of 73% female. As previously indicated in Figure 1, these are the two largest year classes found in this study.
2. Peeler et al. (1976) states that a 1973 Texas Parks and Wildlife study indicated an approximate 66% natural mortality rate in males, that exceeded the rate for females by approximately 50%.
3. Males, because of their smaller size compared to the females and because of the mesh size, tend to escape the net by penetrating it. But of all trout caught in the 3 to 3¼ inch mesh net, larger fish (272 to 578 mm range; 391 average) are generally female; smaller fish (232 to 462 mm range; 354 mm average) are generally males (Figure 2).

CONCLUSION

Female spotted seatrout captured during the study outnumbered males and were generally larger, averaging 15.4 inches and weighing 1.3 pounds. Males averaged 13.9 inches and weighed 1.0 pounds. Three-year-old fish dominated the catch, with second and fourth year classes comprising the next largest groups. As summarized by Hamley (1975), "Knowledge of selectivity is needed in managing a commercial gill net fishery, as the proper mesh size aids in obtaining the maximum yield, protecting small fish, and minimizing escapement of injured or dying fish." If regulations permit very small mesh sizes, immature fish will be captured, which would remove them from the population prior to spawning. However, if regulations permit only very large mesh sizes, only very large fish will be captured, and there will be a loss of a valuable renewable resource. As suggested by Trent and Pristas (1977), ". . . the fishermen will possibly be prevented from using a mesh size which would result in high capture efficiency on legal-sized fish in the population."

Ongoing projects and future studies should increase the knowledge of the efficiency of gill nets and should further enhance practical management decisions.

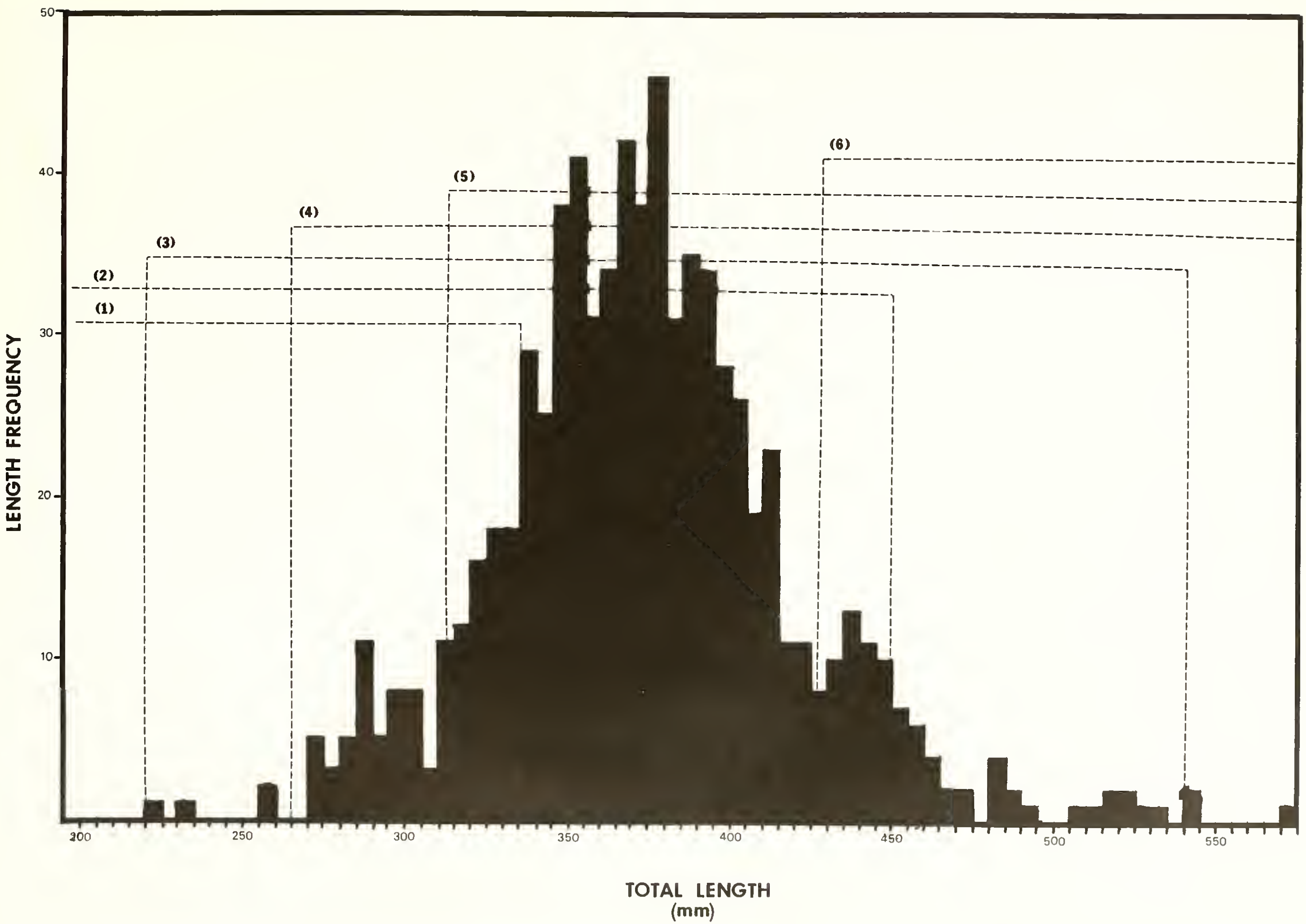

Figure 1. Length frequency distribution for spotted seatrout *(Cynoscion nebulosus)* captured in a 3 to 3¼ inch stretch monofilament gill net. Numbers in parenthesis indicate year classes as proposed by Tabb (1961).

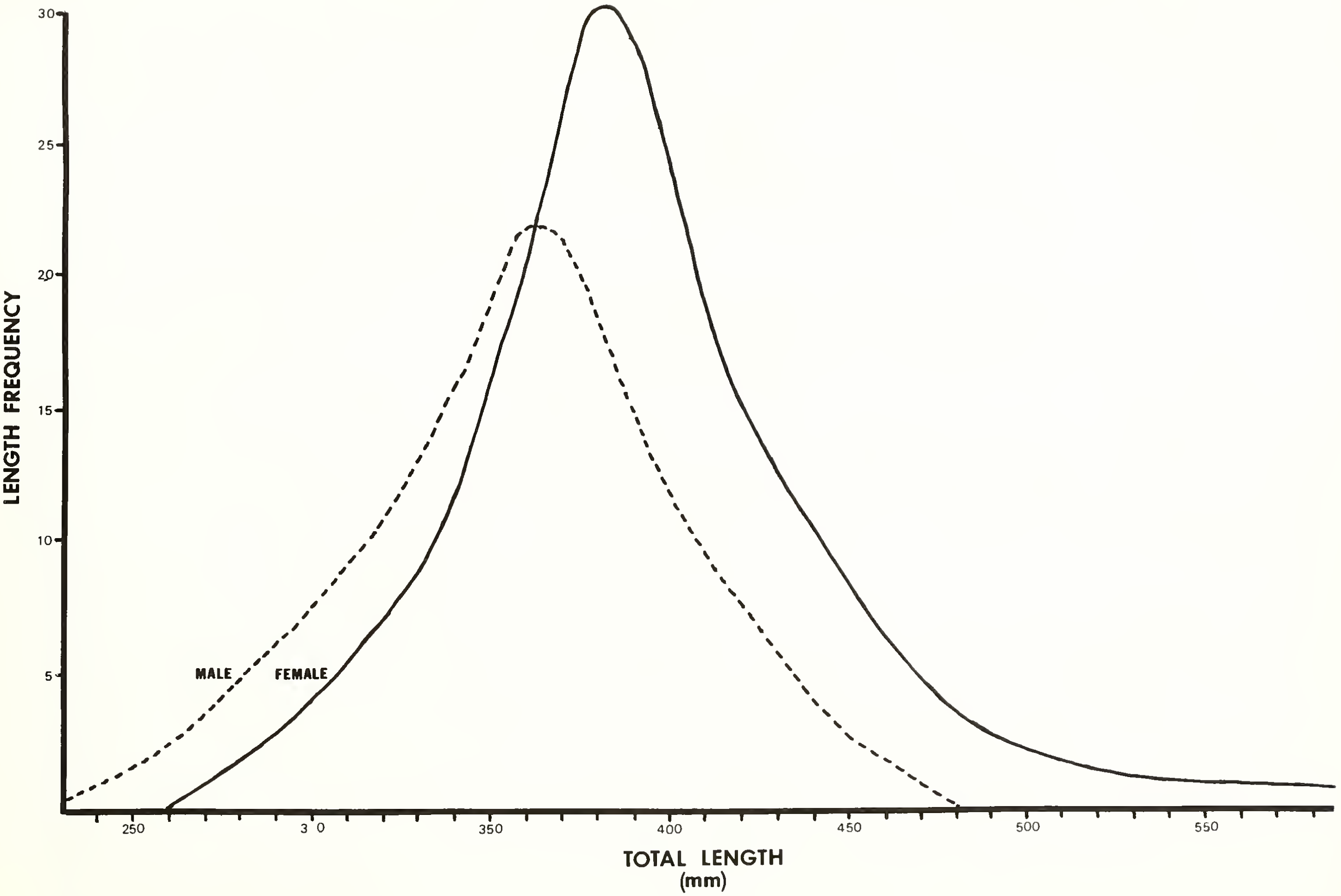

Figure 2. Length frequency distribution of male spotted seatrout compared to female spotted seatrout captured in a 3 to 3¼ inch stretch monofilament gill net.

Table 1
Size of Spotted Seatrout Captured by Monofilament Gill Nets With Mesh Sizes from 2.75 to 3.25 Inches

Author	Location	Mesh Size (Inches)	Time Period	No.	Total Length (mm)	
					Mean	Range
Moffet (1961)	Fort Myers, FL	3.0	Sept. 1958-Oct. 1960	—	—	300-660
	Cedar Key, FL	3.0	Sept. 1958-Oct. 1960	—	—	310-540
Trent and Pristas (1971)	St. Andrew Bay, FL	3.0-3.25	April-Dec. 1973	62	373*	—
Klima and Tabb (1959)	Northwest FL	2.75-3.25	July 1957-June 1958	—	358†	277-556
Tabb (1960)	Indian River, FL	3.13	1955-1957	—	393†	—
Hein and Shepard	Leeville, LA	3.0-3.25	Feb.-Dec. 1976	613	377	232-578

*weighted average.
†calculated total length (TL) from standard length (SL).

Table 2.
Year Classes of Spotted Seatrout as Determined by Other Authors

Year Class	Tabb* (1961)	Miles, et al. Simmons, Breuer (1952)	Winter Class	Pearson* (1929)	Welsh* and Breder (1923)	Moody† (1950)	Klima* and Tabb (1959)
1	196	165	1	150	110-120	30-130	139
2	292	255	2	240	230	200-300	225
3	372	350	3	300	310		300
4	456	432	4	350	360		366
5	535	450	5	400	400		433
6	623	505	6	440	430		494
7		560	7	490			512
8		602	8	520			

Aging Methods
*scale determination.
†length frequency.

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A Drift Bottle Study of the Barataria System

by

WILSON A. BROUSSARD, JR.

Abstract

A total of 357 drift bottles were released in Barataria Bay, Louisiana, and offshore from June 1, 1978, to January 1979. As of January, 1979 there have been 12 returns. All but one bottle were found within a 15-mile radius of Grand Isle, Louisiana. This is an ongoing project. Releases are continuing and more data are being compiled for publication at a later date.

Introduction

Numerous drift bottle studies (Bumpus 1961; Bumpus and Day 1957; Chew et al. 1962; Day 1958; Williams et al. 1977) have been conducted along the United States coasts. Important data have been compiled by gulf coast studies (Chew et al. 1962 and Williams et al. 1977). A knowledge of current patterns is important to marine biologists for predicting movements of plankton, larval fishes, food organisms and pollutants.

Many factors are involved in the movement of the water and hence in the movement of the bottles. Although their exact float route is uncertain, drift bottles do indicate current patterns. Still, all that is actually known is where and when the bottles are released and recovered.

MATERIALS AND METHODS

The bottles used were commonly found 12-ounce beverage bottles filled with specific amounts of sand according to the anticipated water salinity. More sand was added for higher salinities and less sand for lower salinities. A balance scale was used to obtain the weighed sum of the bottle, sand, cork, and funnel. This method was tested in aquaria before the bottles were released.

Each bottle contained a self-addressed card with questions about the recovery. Fluorescent orange and red flagging tape was used as an eye catcher. Two 6-inch strips were cut and corked into the bottle, and some tape was exposed on the outside of the bottle. No reward was offered, but letters were later sent to thank individuals who responded.

Releases were consistently made both inshore and offshore. One release was made weekly at each of the 11 stations in Barataria Bay (Figure 1). Offshore, 10 bottles were dropped monthly at each of the stations. For half of the offshore releases, subsurface drifters were prepared and released to minimize the wind factor. In a subsurface bottle, more sand was added so that the bottle would remain buoyant 12 inches below the surface of the water. Surface drifters were dropped at estuarine stations; both subsurface and surface bloaters were dropped offshore.

RESULTS AND DISCUSSION

The Barataria system drift bottle study began on June 1, 1978, and is currently in progress. There will be a followup report when new and conclusive data are collected. As of January, 1979 357 bottles have been released and 12 have been recovered (Table 1). This yields a percentage return of 3.36 percent.

All returns but one have been recovered within a 15-mile radius of Grand Isle, Louisiana. The exception was a bottle that reached Gulf Breeze, Florida. The release and recovery stations of the returned bottles are shown on Figures 2 and 3.

Among the major factors controlling bottle movement are winds, tides, and gulf currents. For estuarine releases, winds (Table 2) and tidal currents control bottle movement. For offshore releases, the Gulf Loop current (Figure 2) must be considered; however, bottles would have to move southward of the Barataria system to be affected by the Loop current. Another consideration is the Coriolis force, which would definitely affect current patterns in this area.

Bottle 63 was released 14 miles south of Barataria Pass on June 22, 1978, and was recovered on the beach near Gulf Breeze, Florida, on August 11, 1978. It was afloat a total 51 days. Its eastward movement was interesting. It maneuvered around the mouth of the Mississippi River and moved against the Coriolis force. It is possible that the bottle moved southward from its release point then entered the Gulf Loop current, which gave it the eastward boost.

More conclusions can be made when ongoing releases yield more conclusive data.

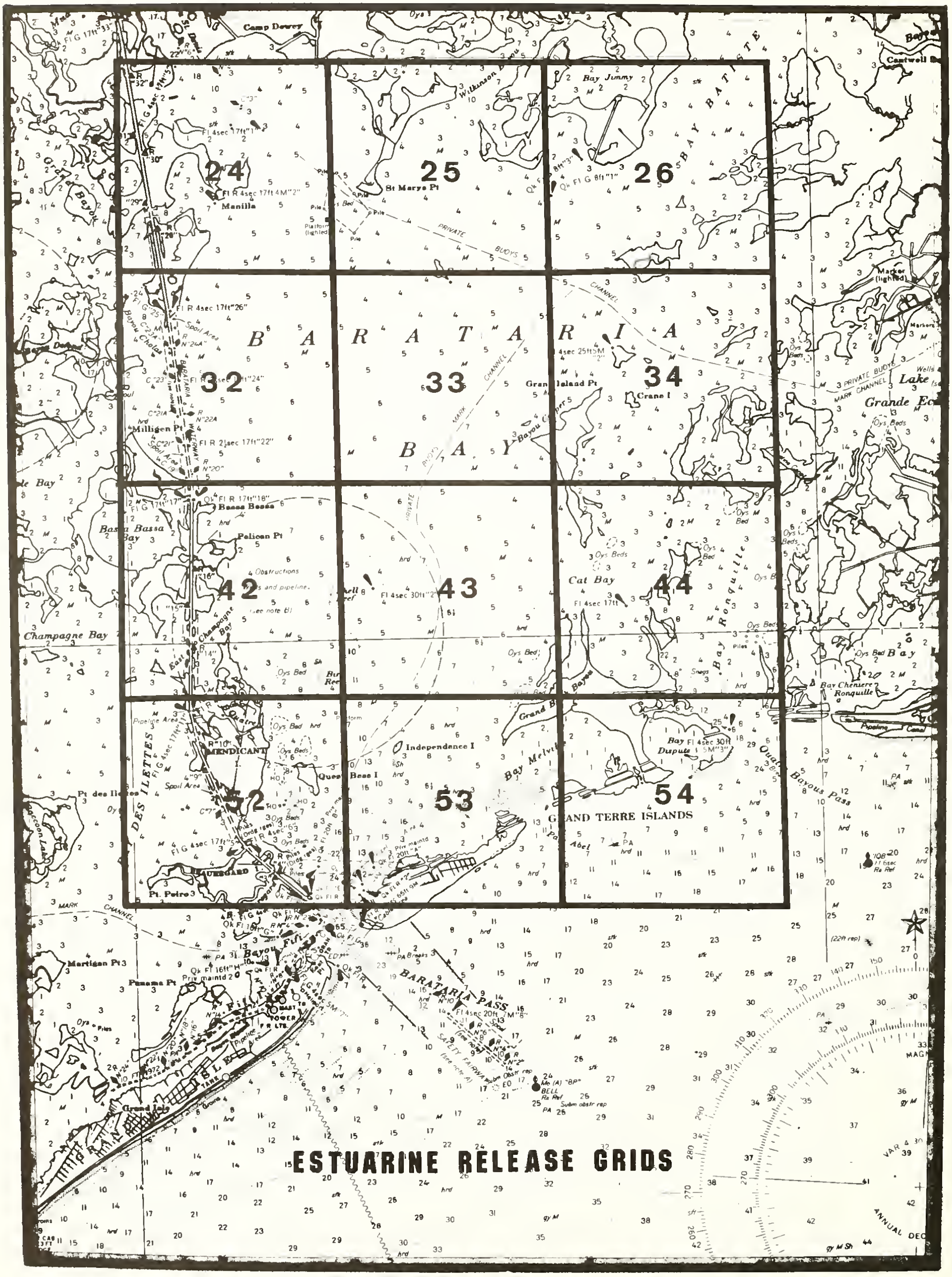


Figure 1. Map of the area with drop stations indicated.

Table 1
Date and Release Stations of Recovered Drift Bottles

Bottle No.	Release Date	Release Station	Recovery Date	Recovery Location
10[8]	6-7-78	42	7-2-78	Chaland Pass, LA
21[8]	6-12-78	42	7-29-78	Barataria Pass, LA
63[8]	6-22-78	14 miles south of Barataria Pass, LA	8-11-78	Gulf Breeze, FL
103[8]	7-11-78	5 miles south of Fourchon, LA	8-23-78	5 mi. E of Fourchon, LA
159[8]	8-16-78	2 miles south of Fourchon, LA	8-31-78	Bay Chanpagne, LA
161[88]	8-16-78	2 miles south of Fourchon, LA	9-13-78	Quatre Bayous Pass, LA
188[8]	8-30-78	33	9-10-78	Pass Abel, LA
212[8]	9-13-78	9 miles south of Barataria Pass	9-18-78	Grand Isle, LA
223[8]	9-14-78	43	9-16-78	Grand Isle, LA
220[8]	9-14-78	52	9-29-78	Barataria Pass, LA
233[8]	9-21-78	Barataria Pass, LA	10-17-78	Grand Isle, LA
274[8]	10-25-78	33	10-29-78	Barataria Pass, LA

[8] - surface drifter
[88] - sursurface drifter

Station numbers shown on Map No. 3.

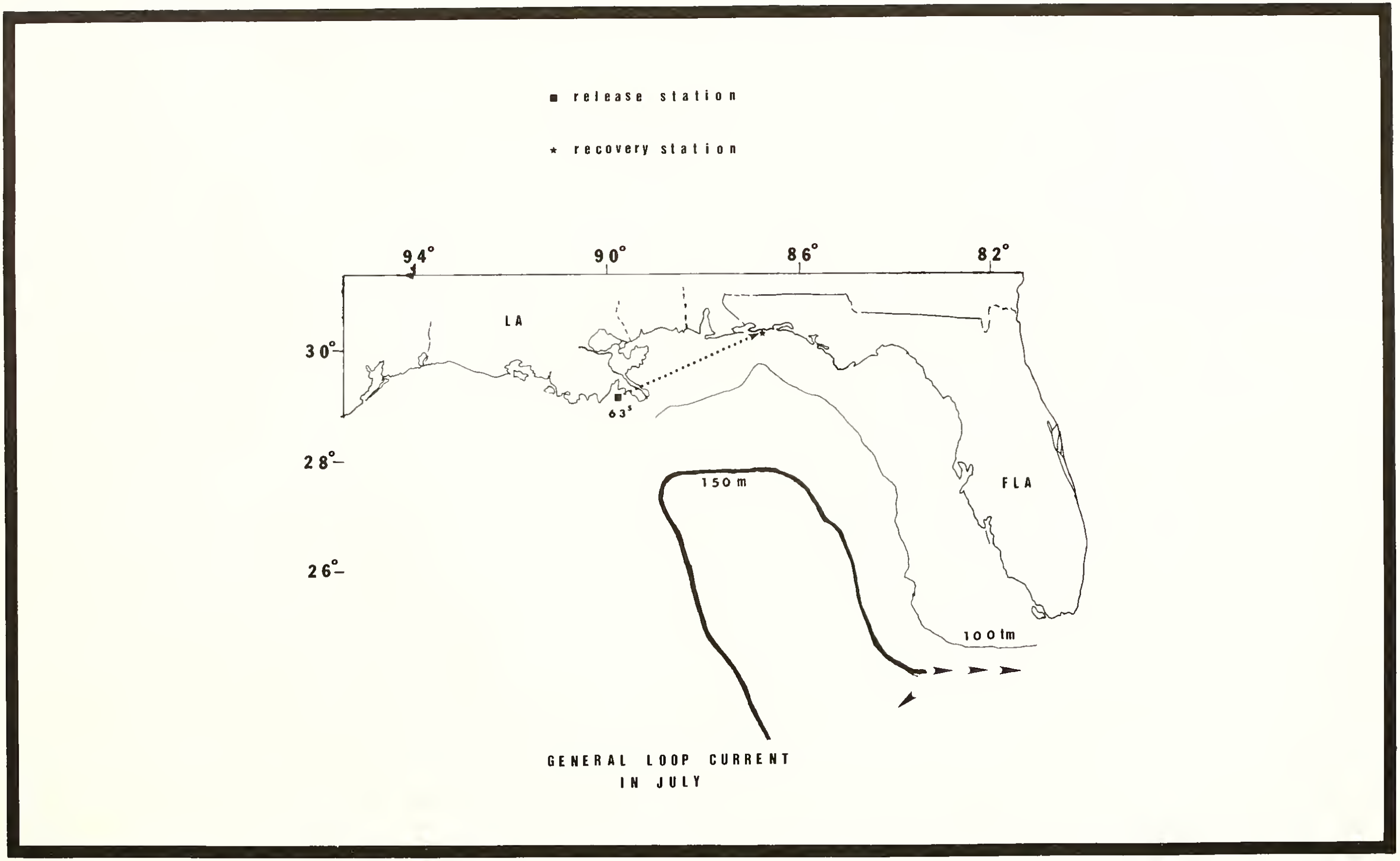
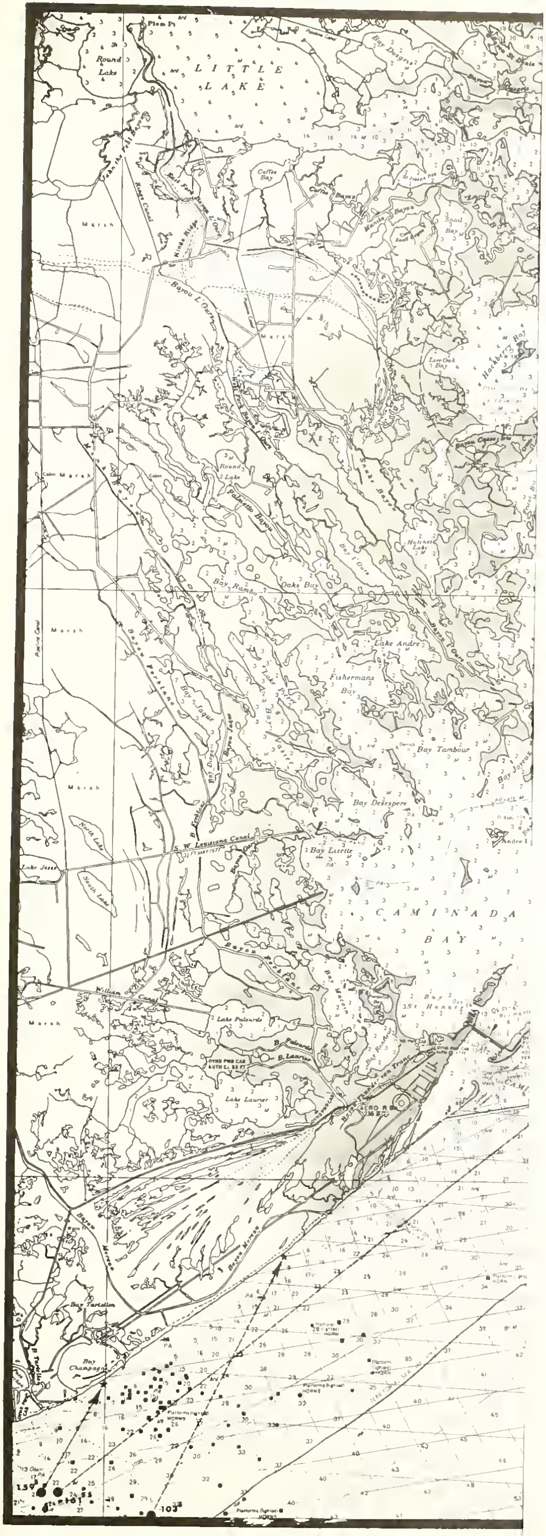


Figure 2. Map of the area indicating the release point and Florida recovery.



Plum Pt
Round Lake
LITTLE LAKE
Coffee Bay
Coffee Bayou
Marsh
Bayou L'Ours
Manila Bayou
Snail Bay
Live Oak Bay
Hackberry Bay
Round Lake
Palmetto Bayou
Hatchet Lake
Bay Rambo
Oaks Bay
Lake Andre
Fishermans Bay
Bay Jaque
Bay Tambour
Bay Desespere
S. W. Louisiana Canal
Bay Lizette
Lake Jesse
North Lake
South Lake
CAMINADA BAY
William Canal
Lake Palourde
B. Palourde
B. Laurier
Lake Laurier
Bay St Honore
Bay Tartellon
Bay Champagne
Bayou Moreau
Platforms (lighted) HORNS

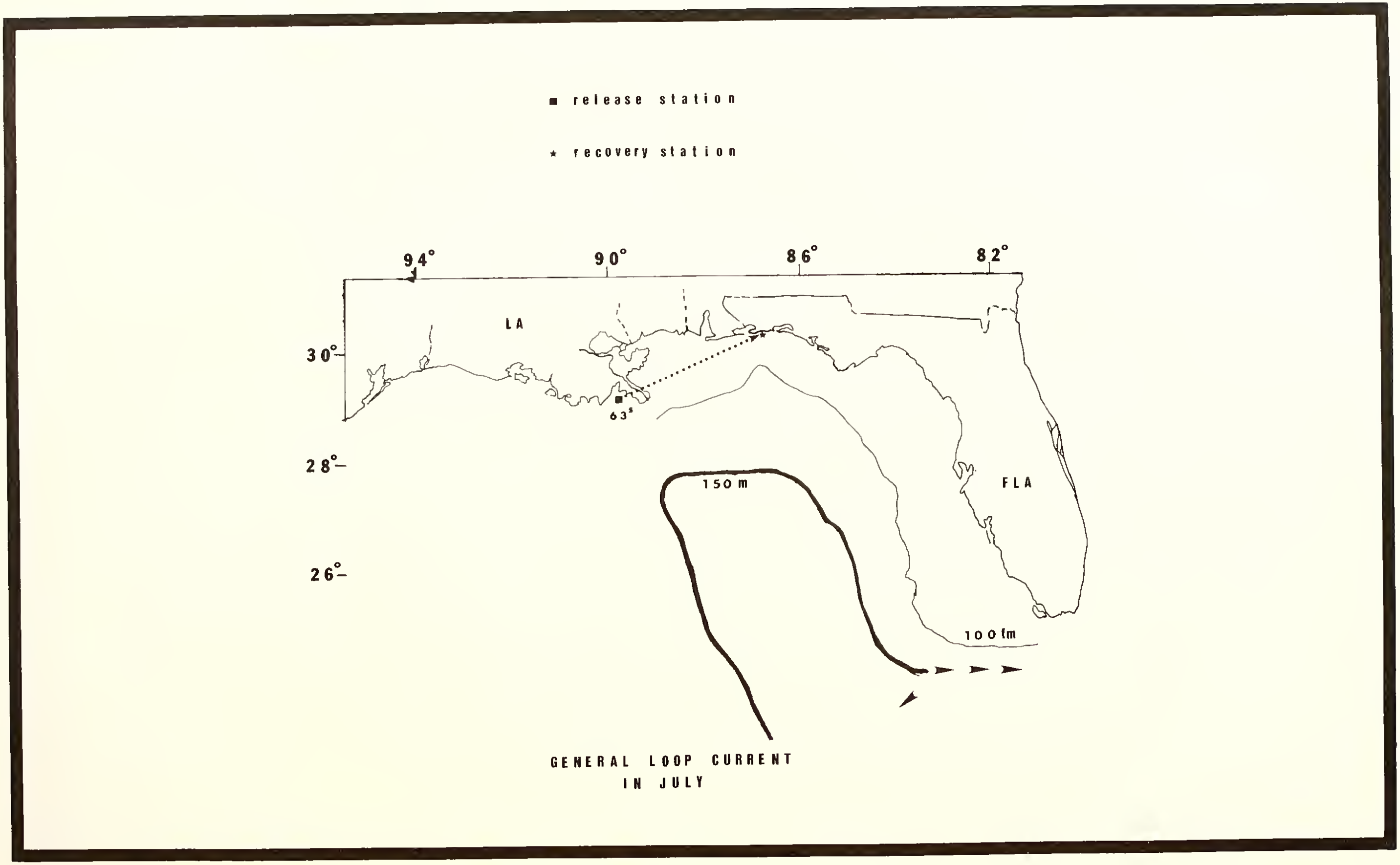


Figure 2. Map of the area indicating the release point and Florida recovery.

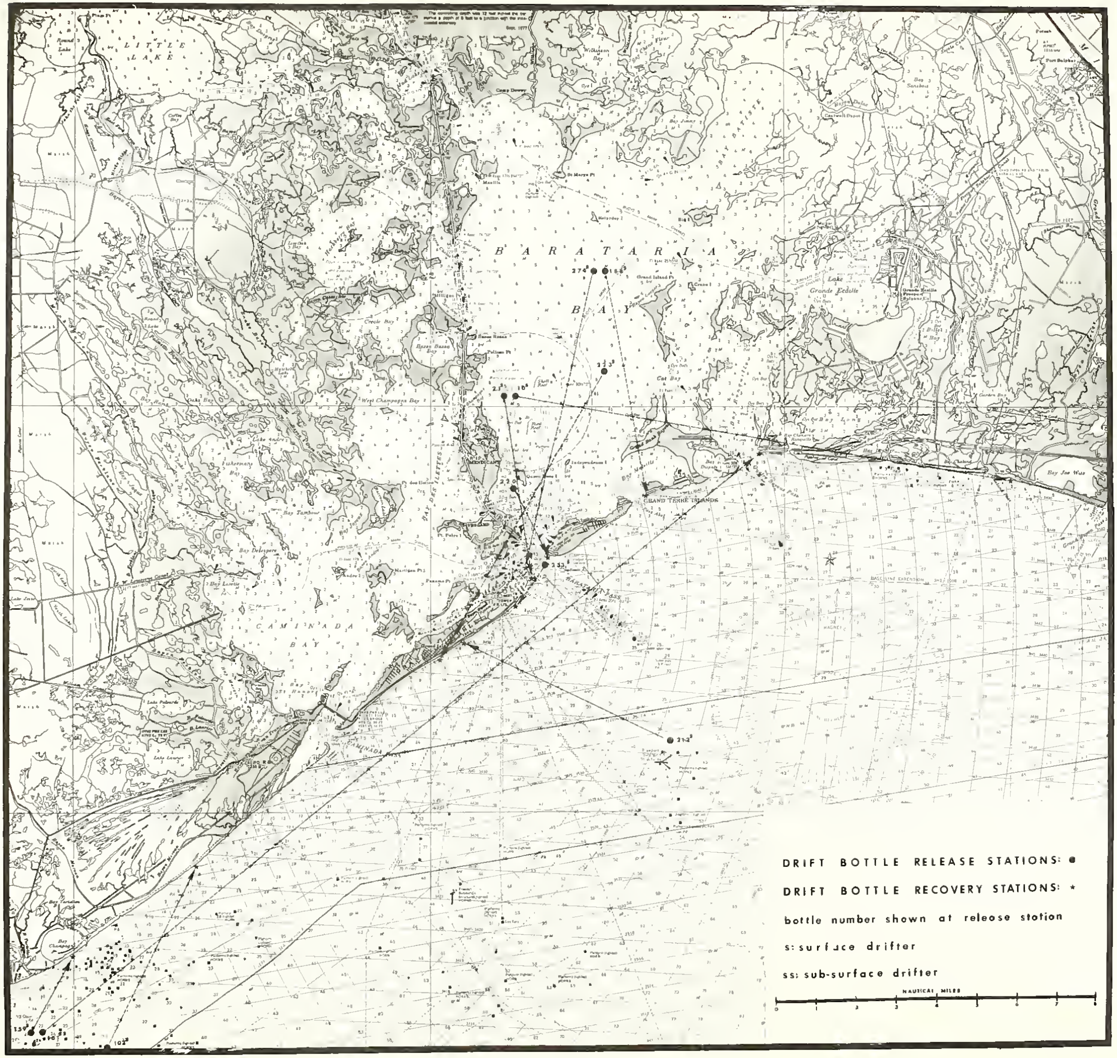


Figure 3. Float bottle releases and recoveries.

Table 2
Average wind directions and velocities (mph) on Release Dates of Drift Bottles

Release Date	Time 12 M-4 AM	4 AM-8 AM	8 AM-12 N	12 N-4 PM	4 PM-8 PM	8 PM-12M
6- 7-78	S-9	SE-2	ENE-9	E-7	E-4	E-4
6-12-78	SW-5	W-2	NW-4	V-5	SSW-7	V-2
6-22-78	SW-2	NNW-2	N-3	SSW-3	SW-4	WSW-4
7-11-78	S-6	SSW-4	V-2	S-5	S-5	S-8
8-14-78	S-7	S-5	SW-3	SSW-5	SSW-5	WSW-4
8-30-78	S-14	SSW-4	SSW-5	W-3	SSE-3	S-4
9-13-78	S8-	S-10	SSW-6	SSW-7	SSW-4	S-8
9-14-78	S-8	S-8	S-6	V-10	ESE-3	ESE-6
9-21-78	ESE-7	E-8	E-9	E-9	E-10	E-12
10-25-78	Calm	Calm	E-4	SE-7	SE-4	SE-4

V - Variable.

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Salinity Trends in Barbataria Bay, 1978

by

MYRON FISCHER

Abstract

Seasonal variations in salinity in Barataria Bay, Louisiana, and the influence of wild and rainfall are presented.

Introductions

Two important factors affecting marine organisms in their natural environment are salinity and temperature. These parameters are vital to such functions as migration, growth, and reproduction in our estuarine area. Biologists must know past hydrological occurrences and how organisms reacted so they can explain what happened in the past and use that information to predict and correlate future events.

Louisiana's coastal region averages nearly 60 inches of rainfall per year. This rainfall tends to decrease the salinity in the estuarine system, especially in the northern portion of the bays. When this effect is coupled with northerly winds, the entire bay system becomes affected by the precipitation. The counter of this action is a tidal push of high saline Gulf waters into the bay. Extreme southerly and southeasterly winds tend to push the high saline waters to the northern shore of the bays. During extended periods of low rainfall, the high saline waters also enter into the broken marsh that borders the northern portions of the bay (Van Sickle et al. 1976). Because of the importance of increasing our knowledge of the dynamics of these physical parameters, the present study was undertaken.

METHODS AND MATERIALS

The area investigated was Barataria Bay, Louisiana, and the smaller adjacent bays in the immediate area. The area includes large, open bodies of water containing small broken islands. These small islands are more numerous in the southern portion of the estuaries where the effects of waves, offshore tidal action, hurricane destruction, and subsidence are all greatly increased. A complete area description was presented by Perret et al. (1971).

The sample area was divided into 3-mile grid squares (Figure 1). Weekly top and bottom salinity and temperature readings were taken, if geographically possible, at the center of each 3-mile grid. The surface reading was taken at a depth of one foot below the surface, and the bottom reading was taken at one foot above the bottom. From the salinity data gathered, weekly, monthly, and annual isohalines were calculated. These isohalines were plotted in 5 ppt intervals, ranging from 5 to 30 ppt. The instrument used to obtain these readings was a Beckman RS5-3 induction salinometer.

RESULTS AND DISCUSSION

The 12 monthly isohalines are illustrated in Figures 2 through 13. The months with the highest salinity appear to be March and July. These months are characterized by southeast and southerly winds that push the saline Gulf waters inward. High salinities also occurred in October and November, caused partly by southeasterly winds and low rainfall. Winter north winds caused the low salinity in January and February in the northern part of the system. An annual isohaline of Barataria Bay indicates that the 15 ppt isohaline line occurs laterally through the bay (Figure 14). This 15 ppt line is similar to the mean salinity pattern of Hewatt (1947). This similarity indicates that drastic or radical changes in mean salinity have not occurred over the past 20 years. However, it does not indicate that saltwater intrusion is not taking place. Van Sickle et al. (1976) have documented a salinity increase in northern Barataria Bay.

As mentioned previously, intense rainfall and northerly winds can drastically reduce the salinity. Such a reduction was witnessed on January 26, 1978, when the 5 ppt line appeared near Independence Island in southern Barataria Bay (Figure 15). The reverse of this was seen when, with low rainfall, the 25 ppt line dissected the upper reaches of Barataria Bay (Figure 16).

The last salinity-related phenomenon to be mentioned is that of a salt wedge. A high saline "salt wedge" can become locked in the northern reaches of bay, with lower salinity water appearing seaward (Figure 17). The salt wedge can be caused by the pushing of high salinity water into a pocket of bay waters while salinity changes take place in the remainder of the system. Another means by which salt water becomes locked in is by strong southeasterly winds that push the high saline waters far into the bay. Continued winds of high velocity and southeasterly magnitude will push fresh river water into the area and eventually across the southern boundaries of the bay.

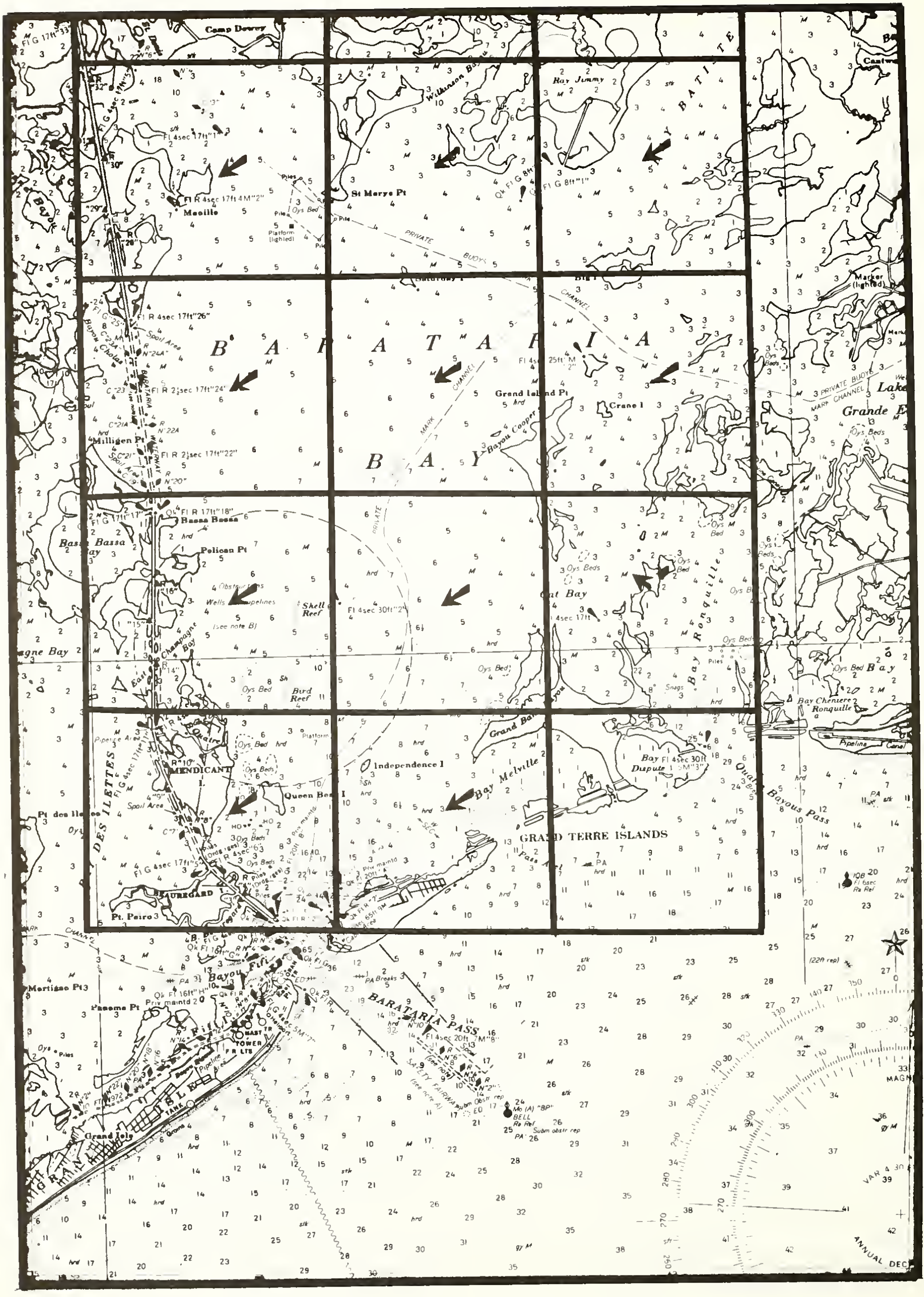

Figure 1. Location of sampling stations in Barataria Bay.

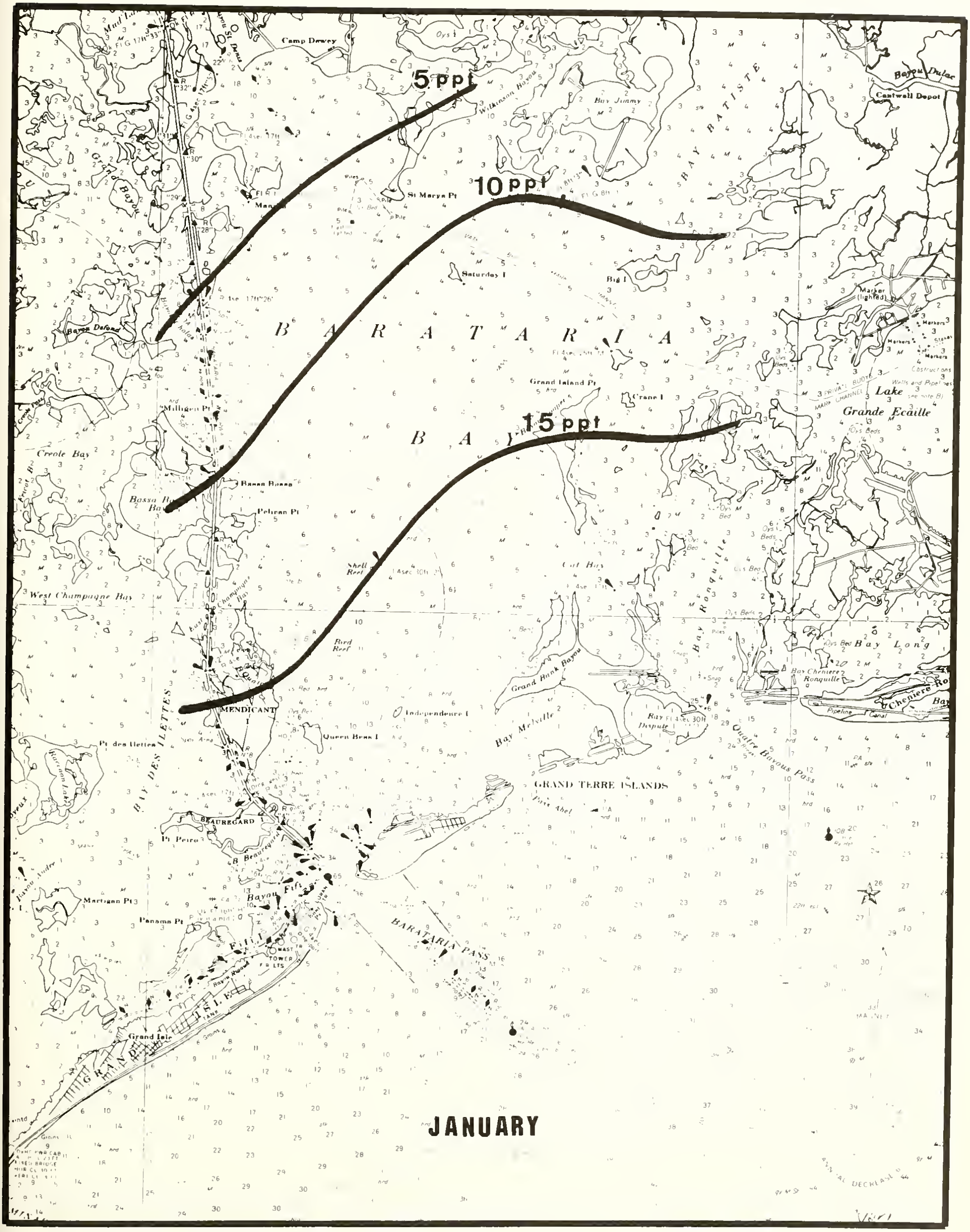

Figure 2. Monthly bottom isohalines for January 1978.

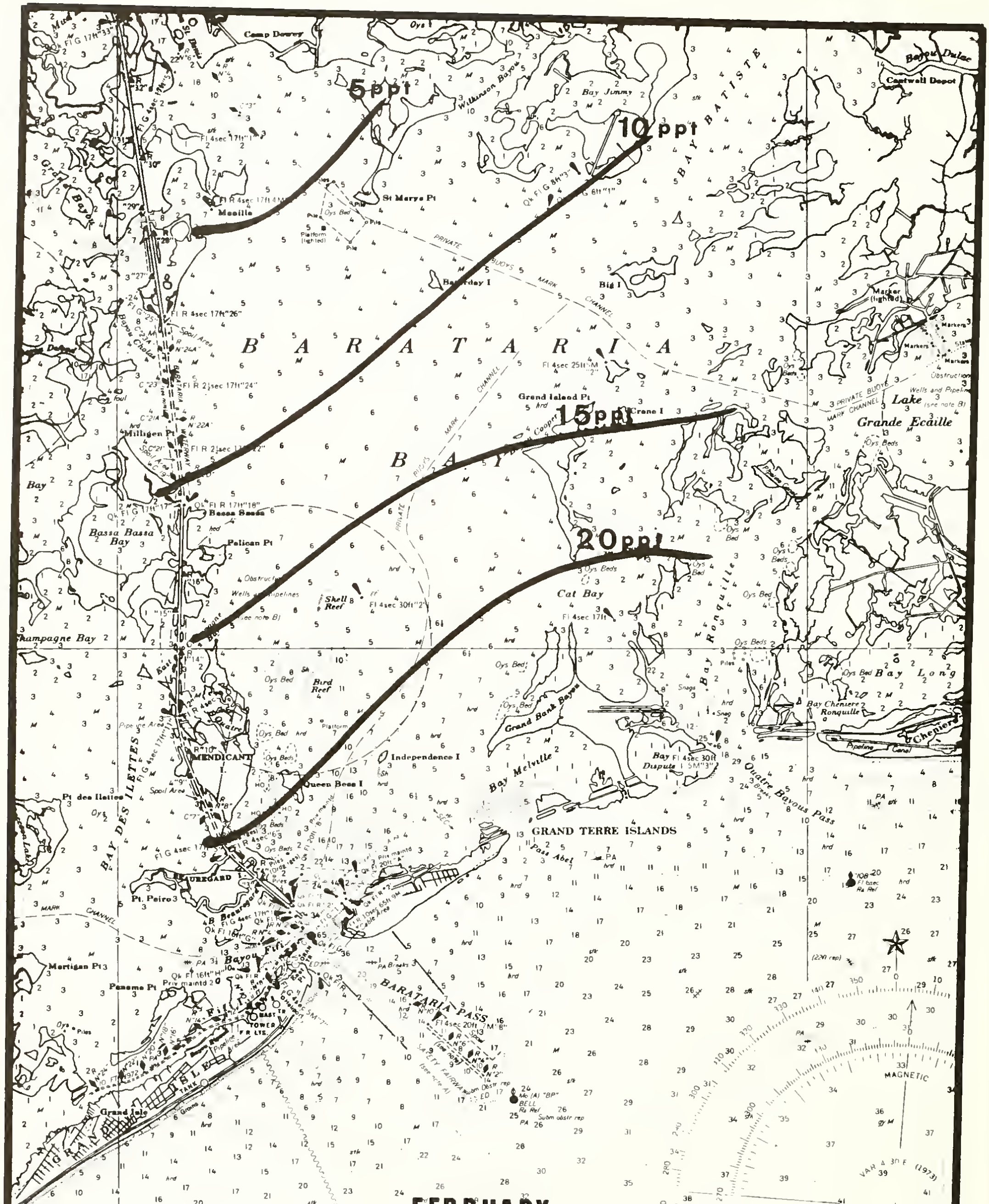

Figure 3. Monthly bottom isohalines for February 1978.

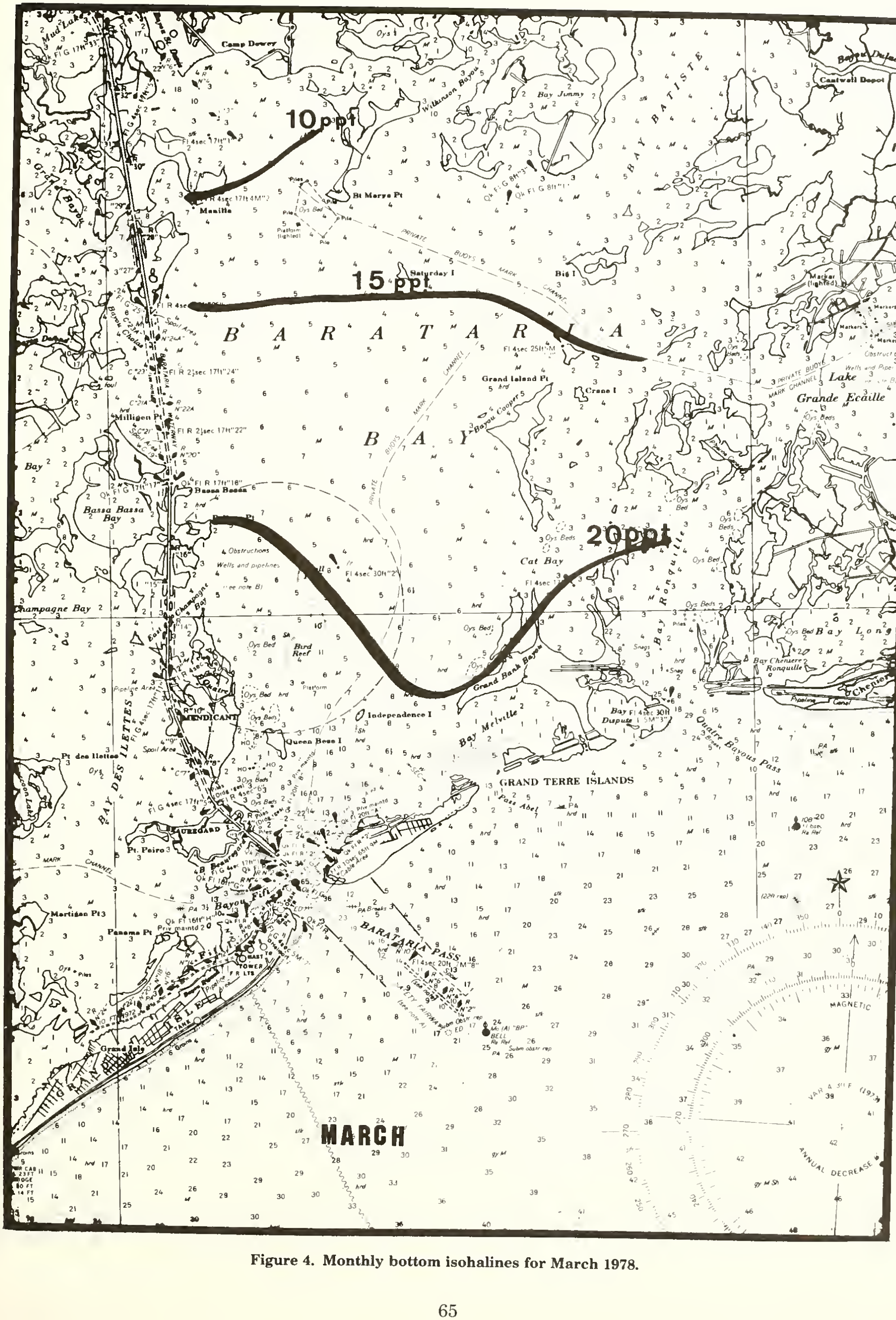

Figure 4. Monthly bottom isohalines for March 1978.

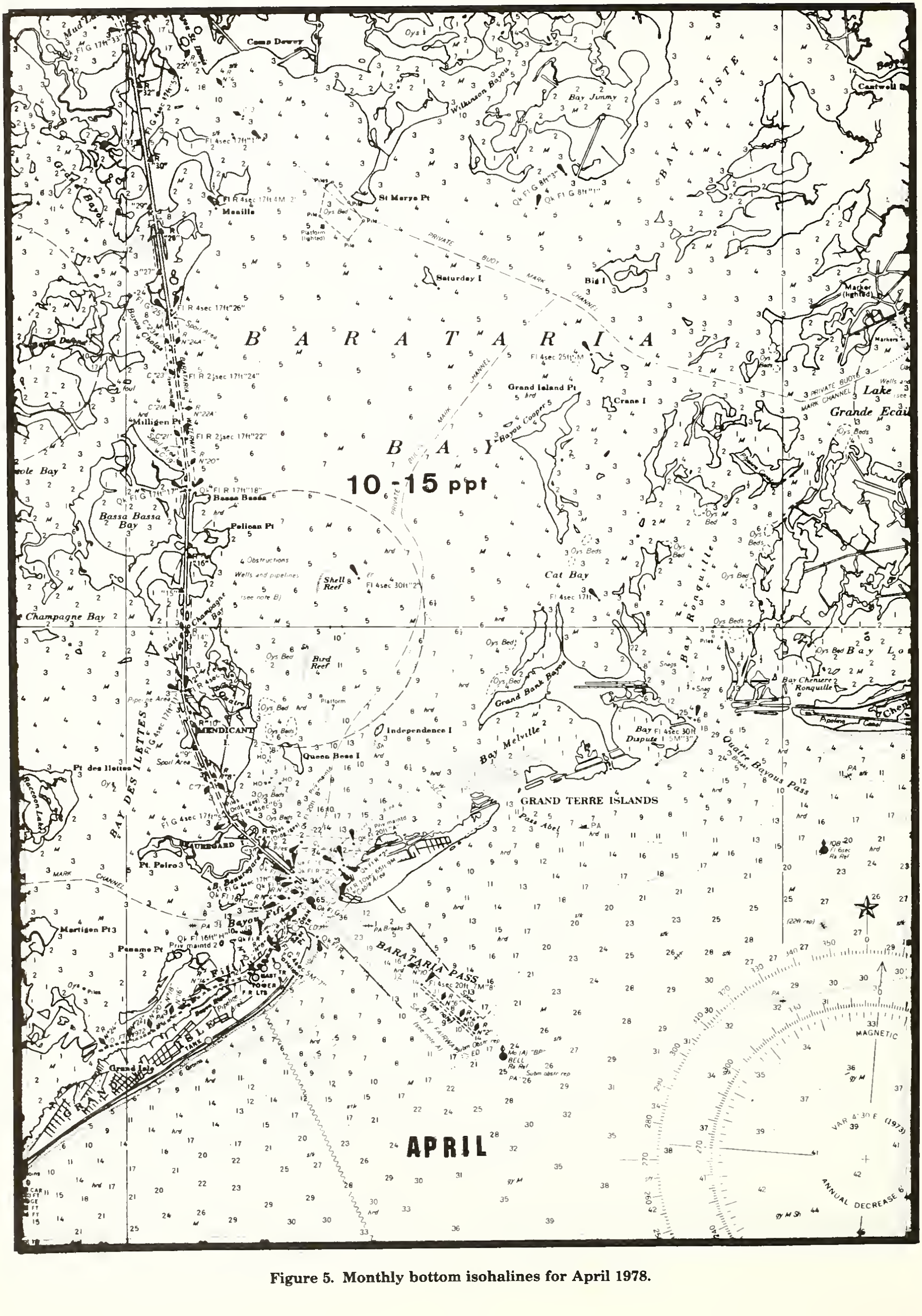

Figure 5. Monthly bottom isohalines for April 1978.

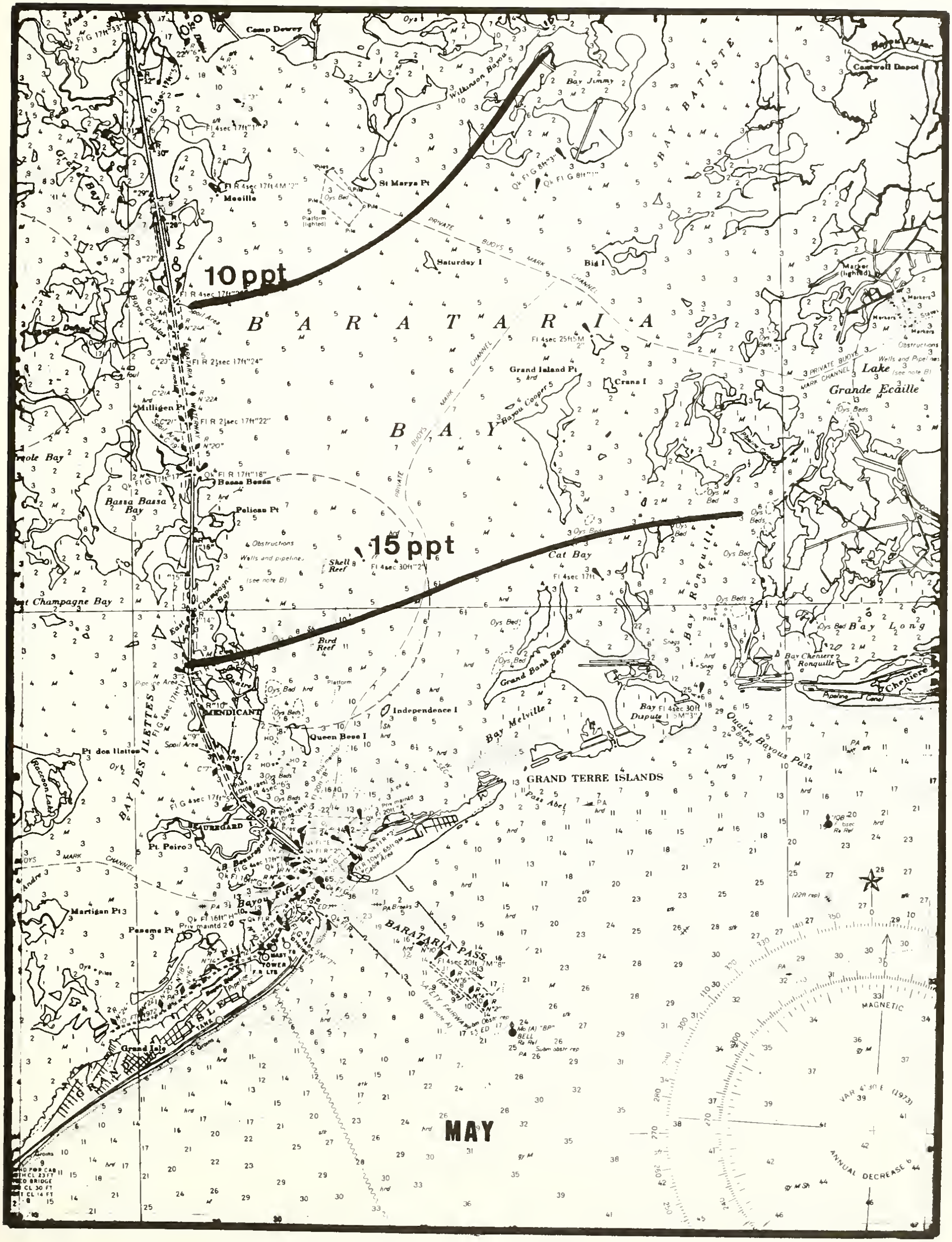

Figure 6. Monthly bottom isohalines for May 1978.

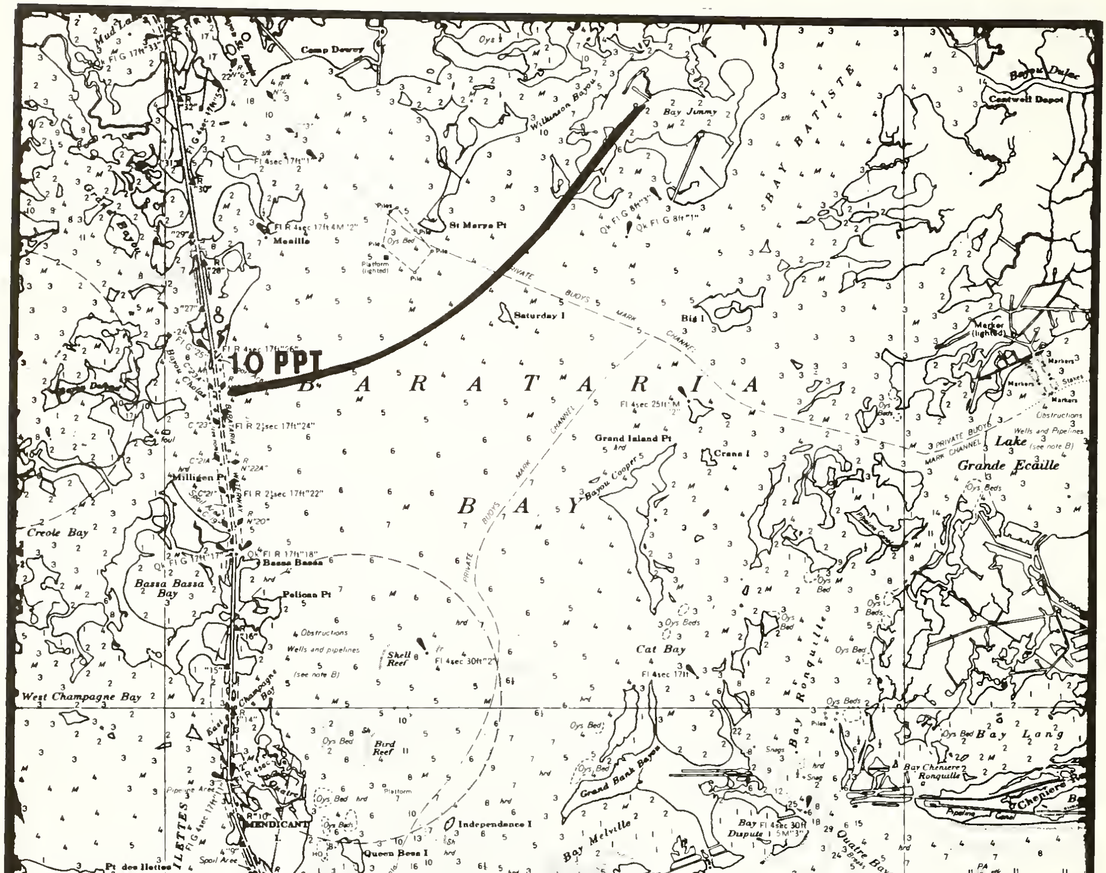

Figure 7. Monthly bottom isohalines for June 1978.

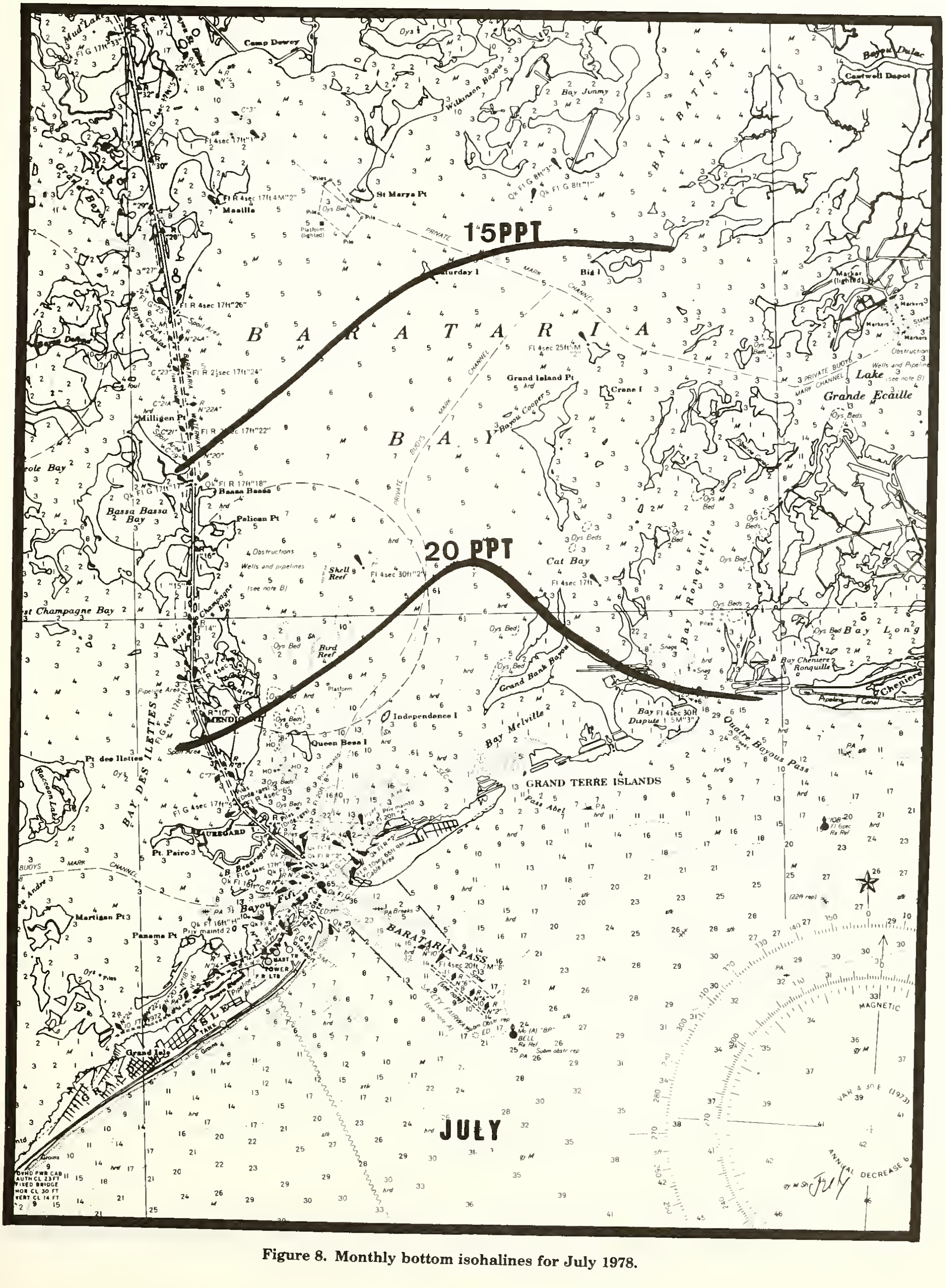

Figure 8. Monthly bottom isohalines for July 1978.

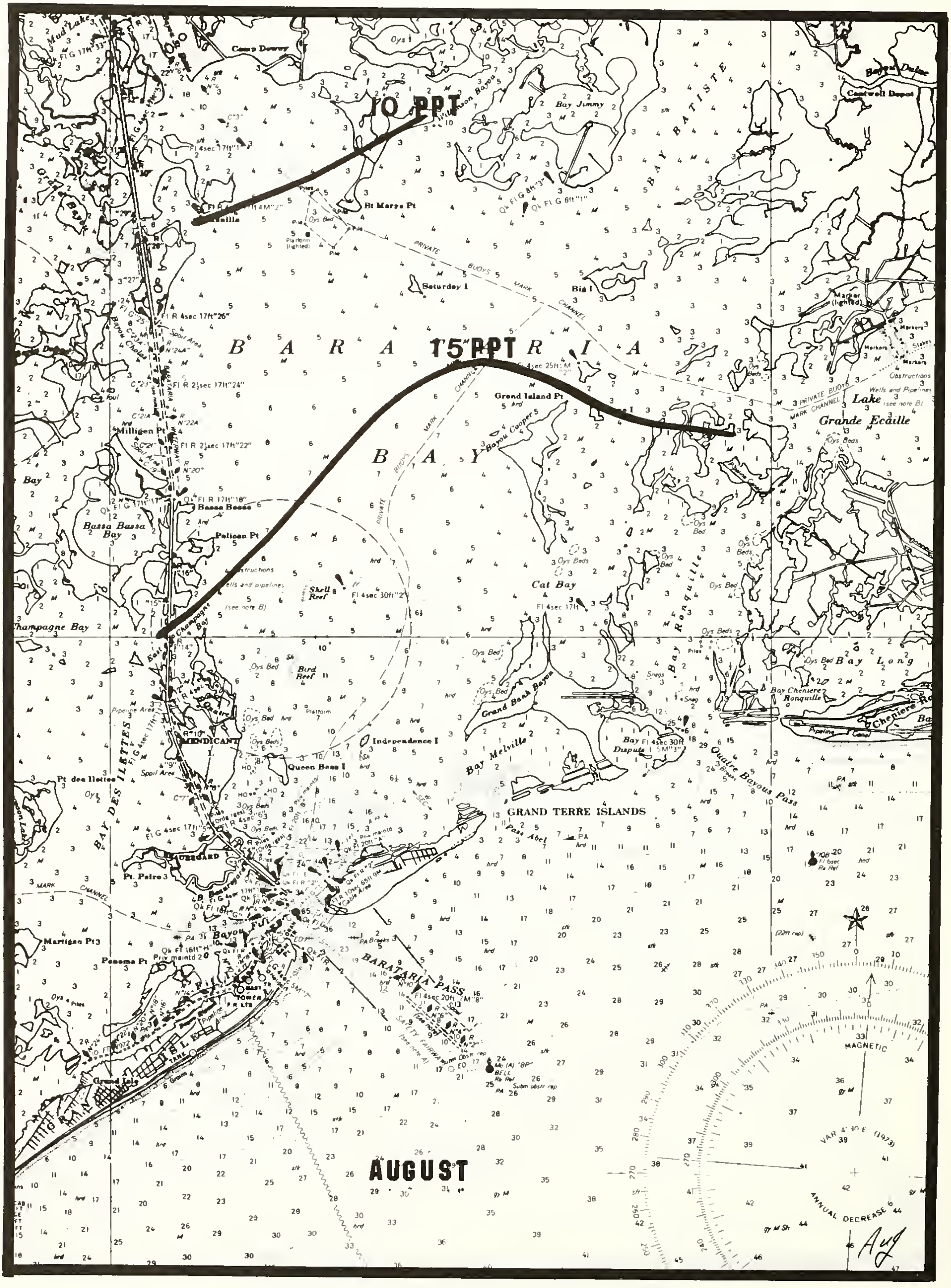

Figure 9. Monthly bottom isohalines for August 1978.

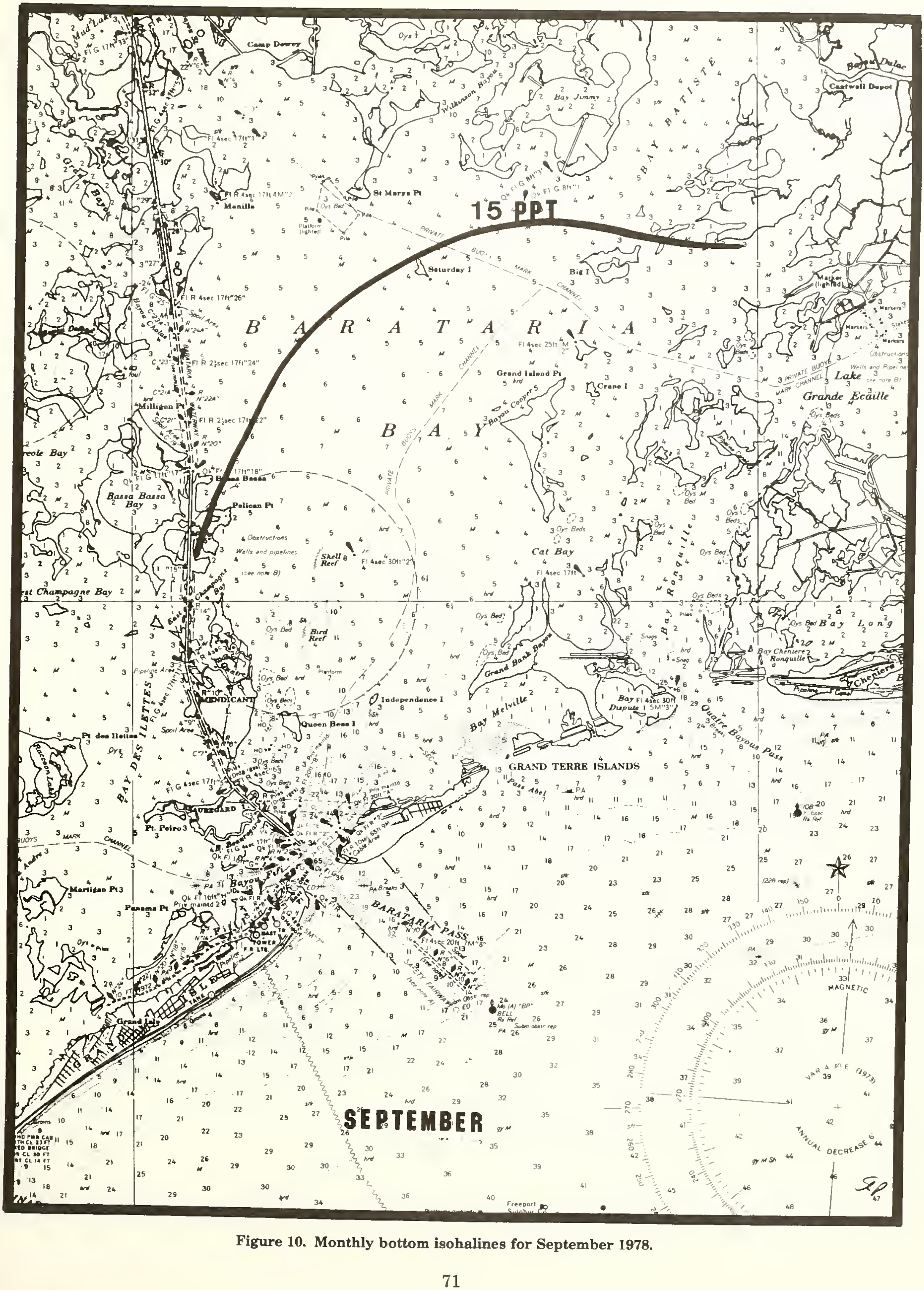

Figure 10. Monthly bottom isohalines for September 1978.

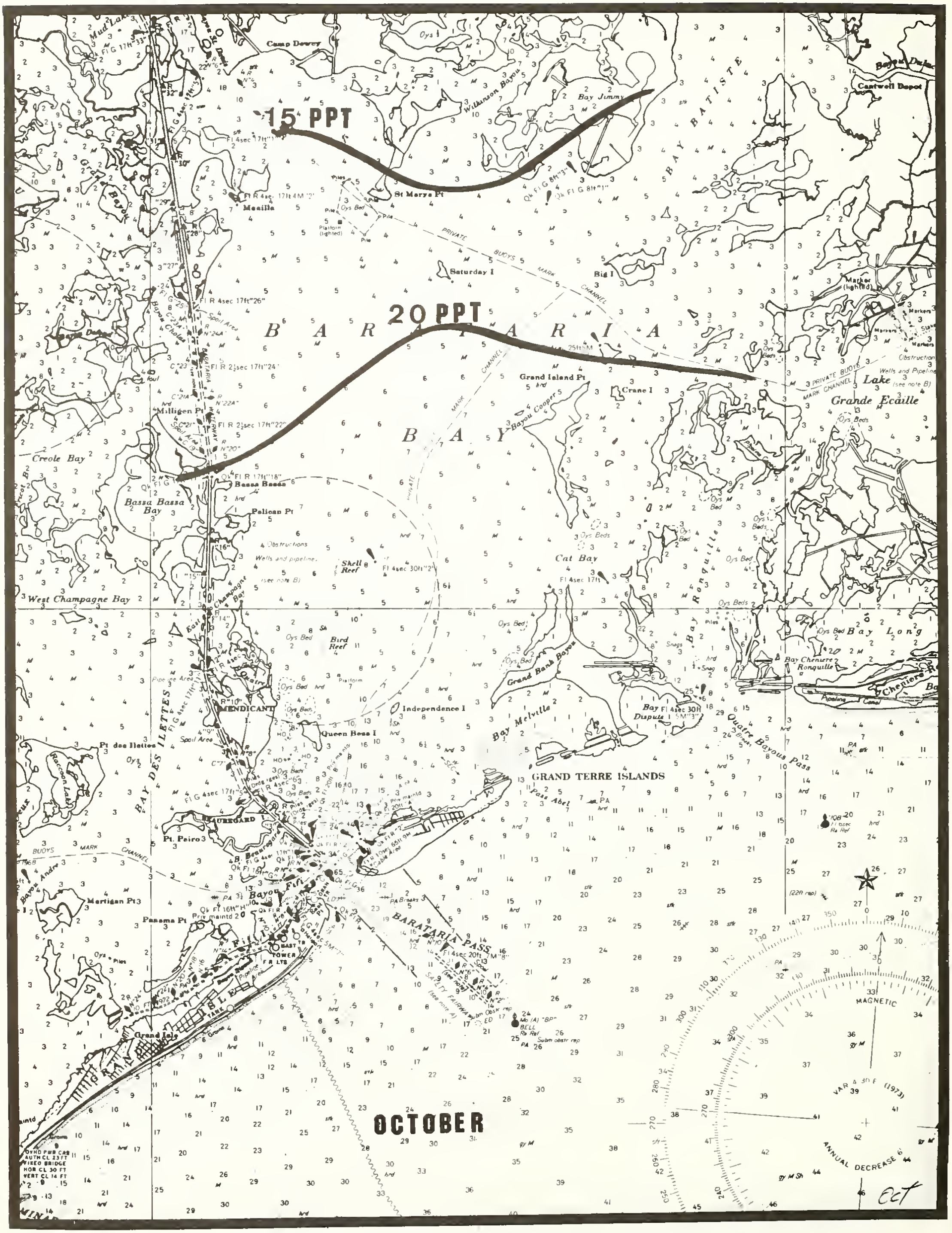

Figure 11. Monthly bottom isohalines for October 1978.

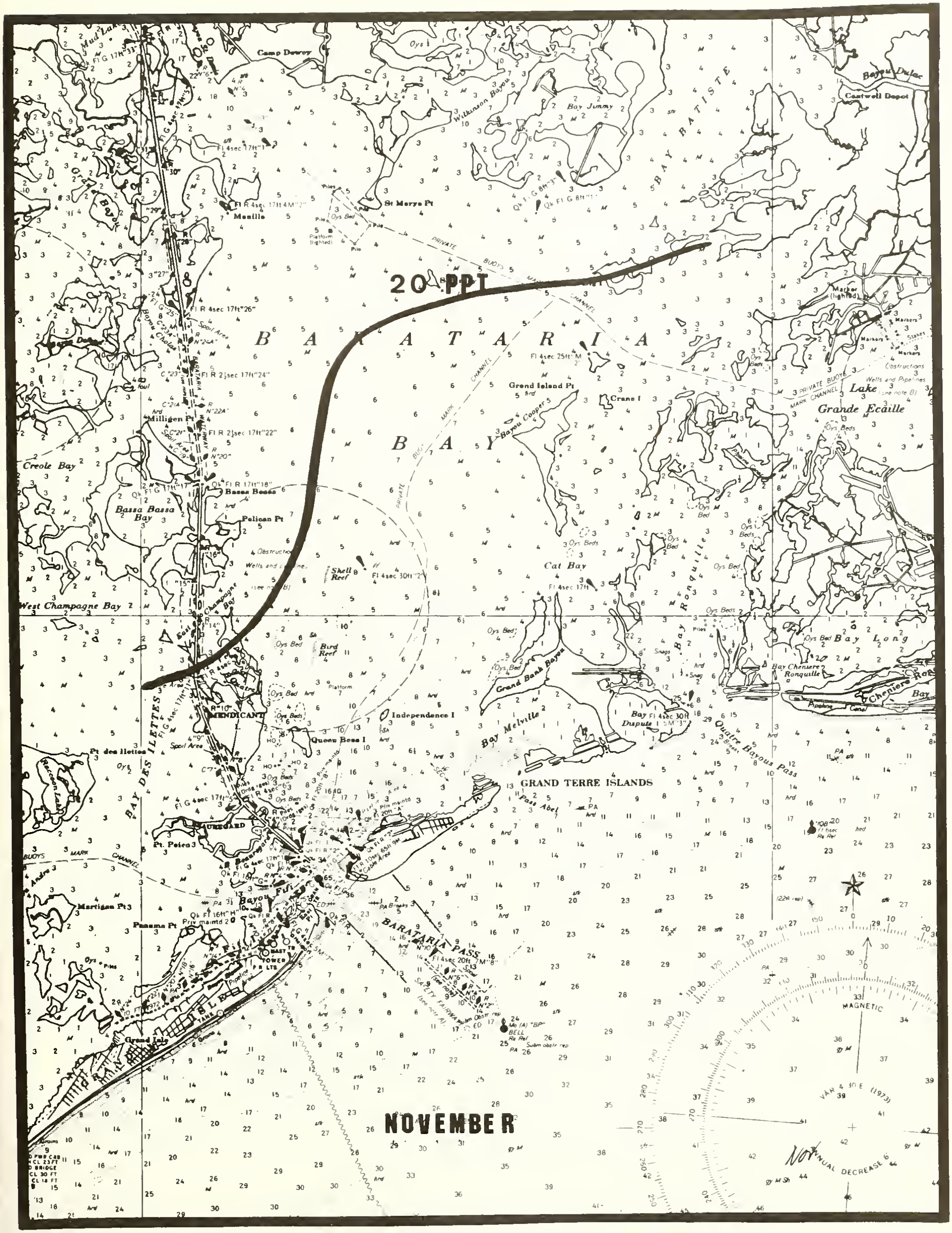

Figure 12. Monthly bottom isohalines for November 1978.

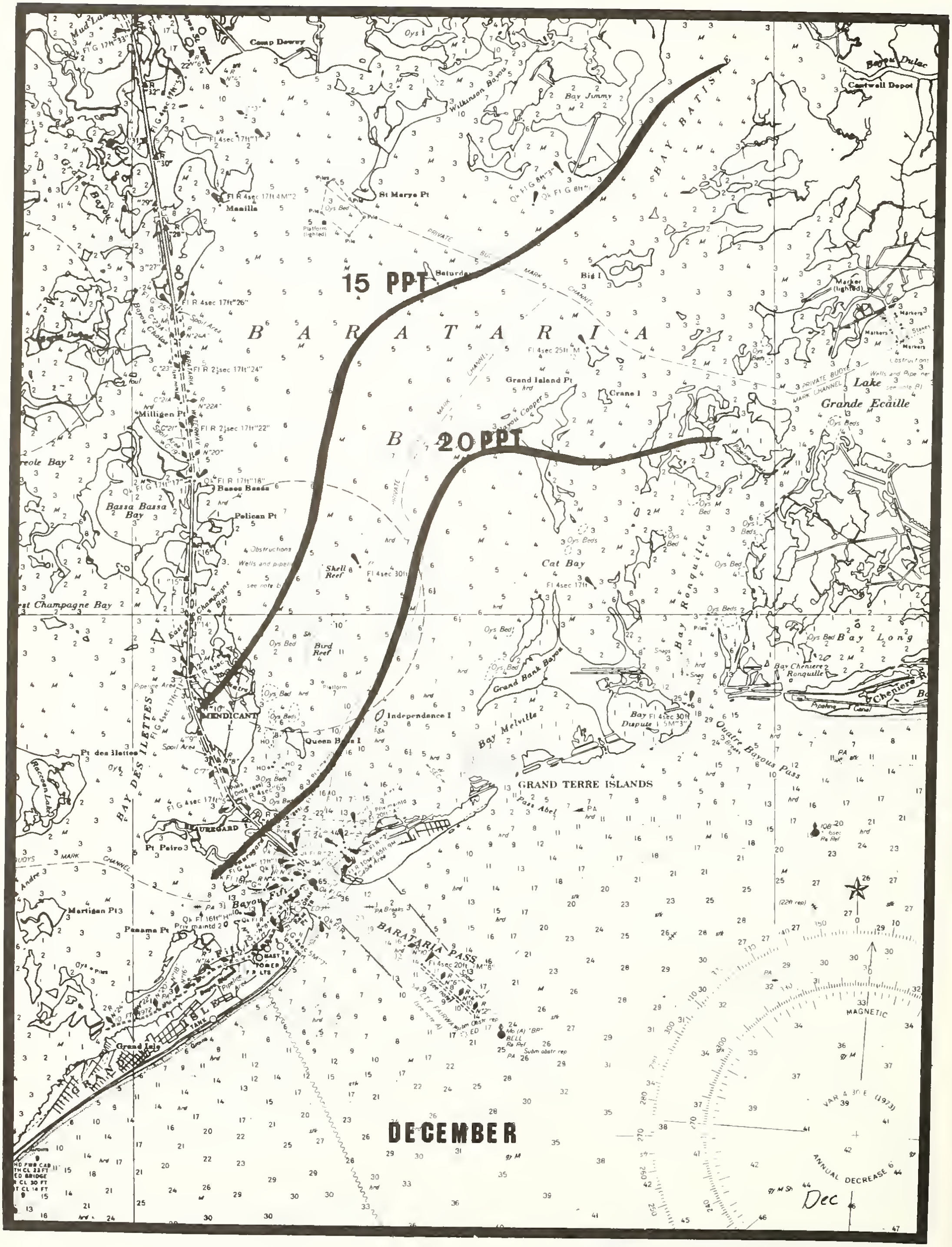

Figure 13. Monthly bottom isohalines for December 1978.

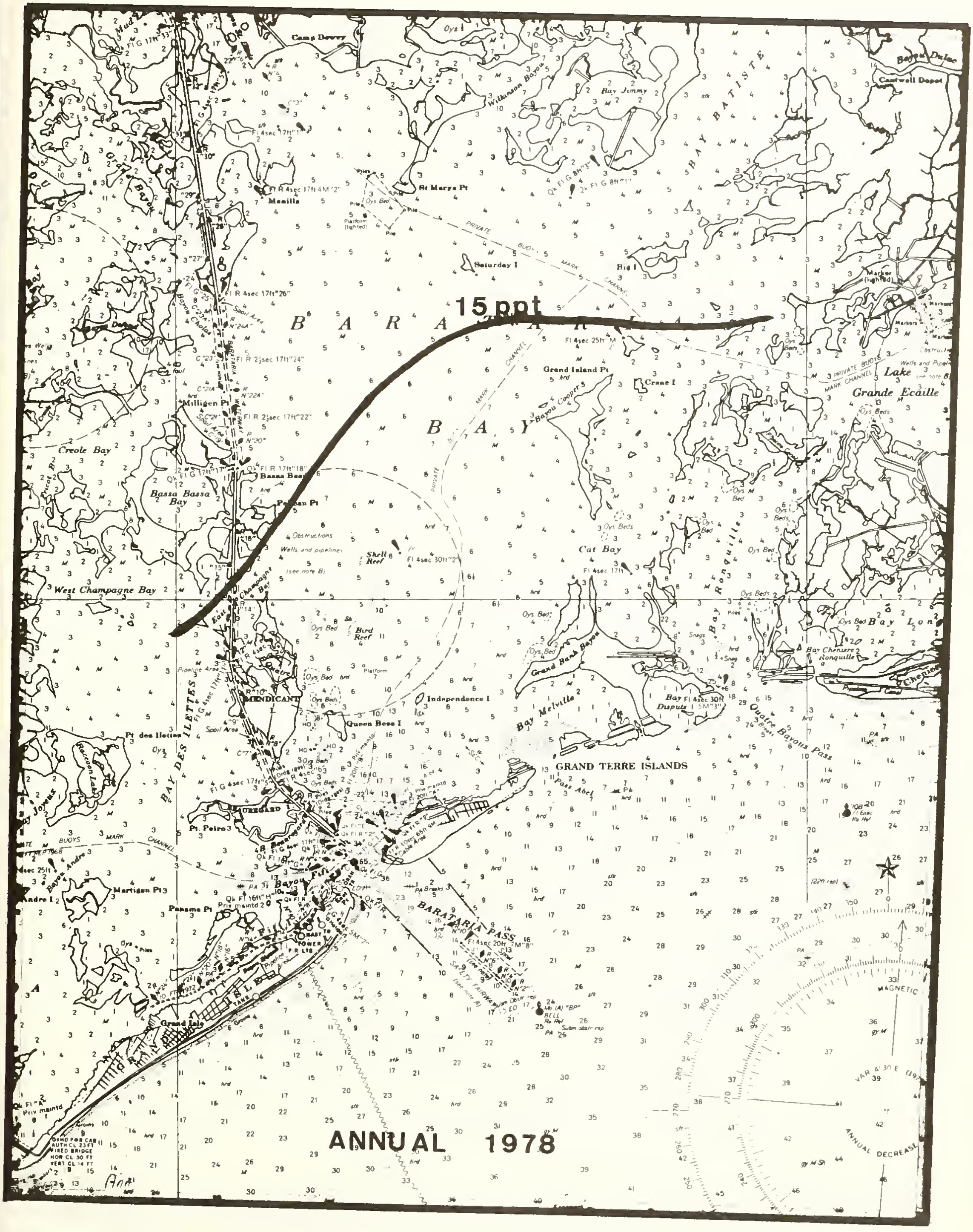

Figure 14. Average bottom isohalines for 1978.

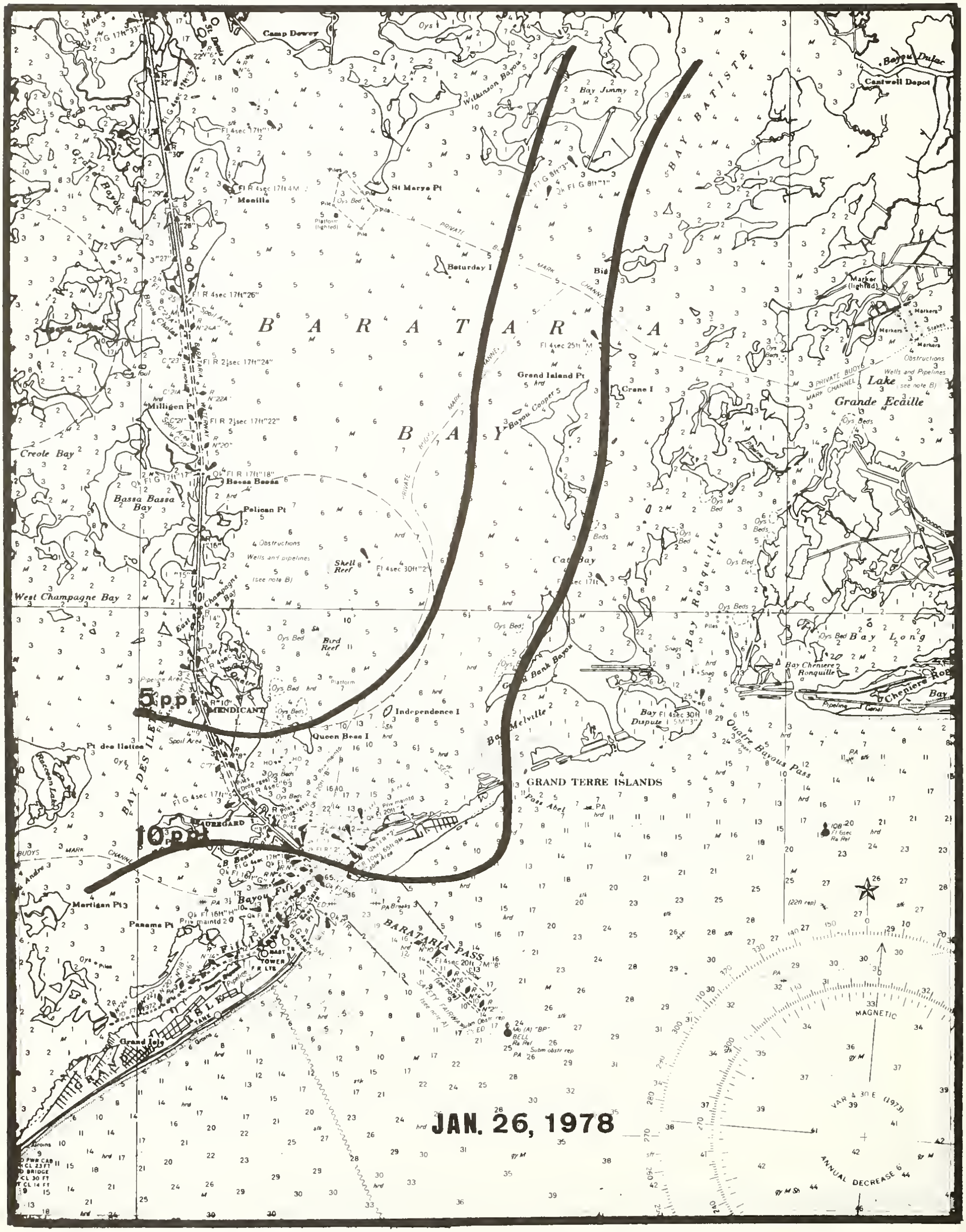

Figure 15. The January 26, 1978 bottom isohalines indicating the effects of north winds coupled with heavy rainfall.

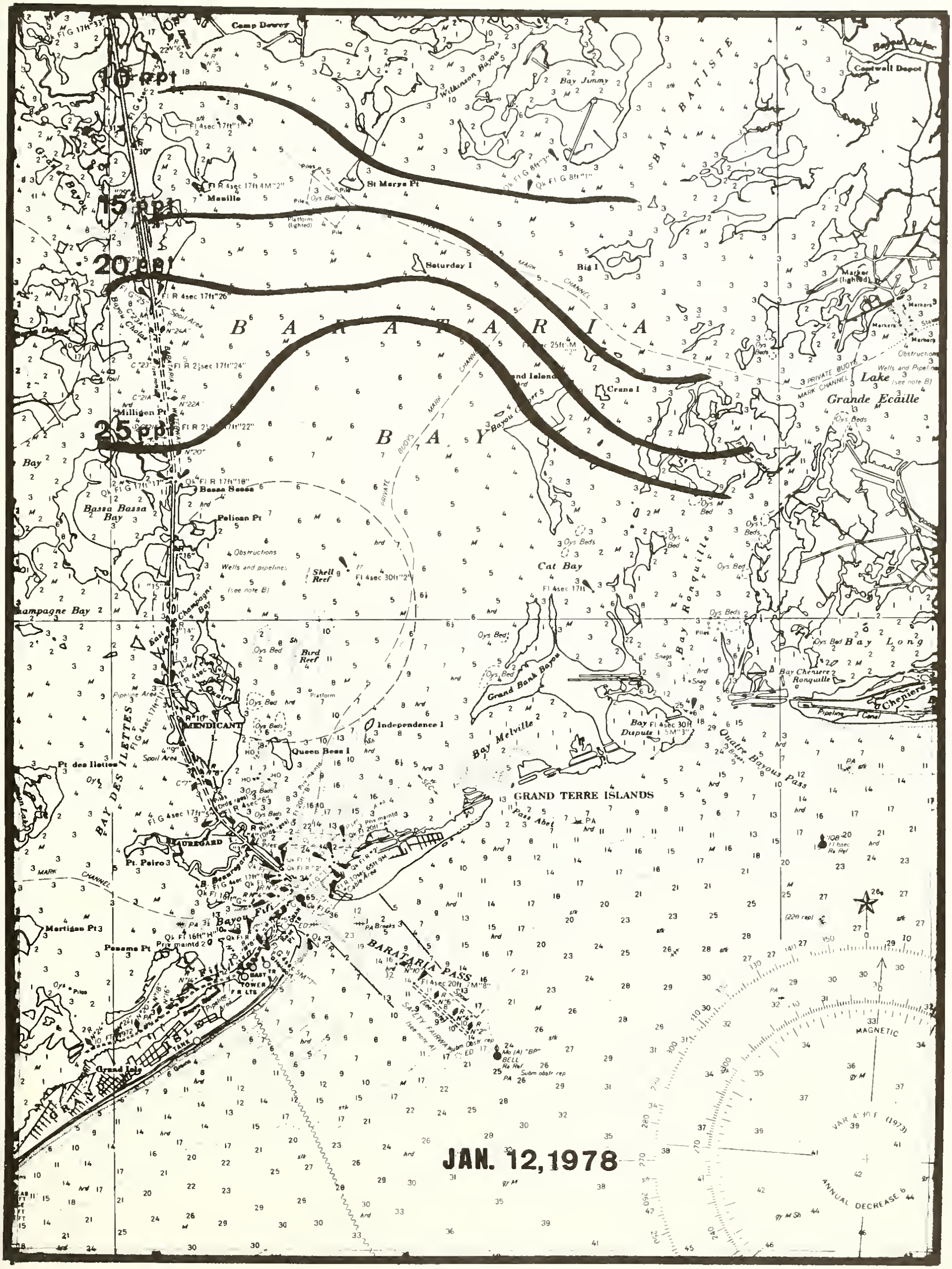

Figure 16. The effects of low rainfall and strong southerly winds on salinities in Barataria Bay.

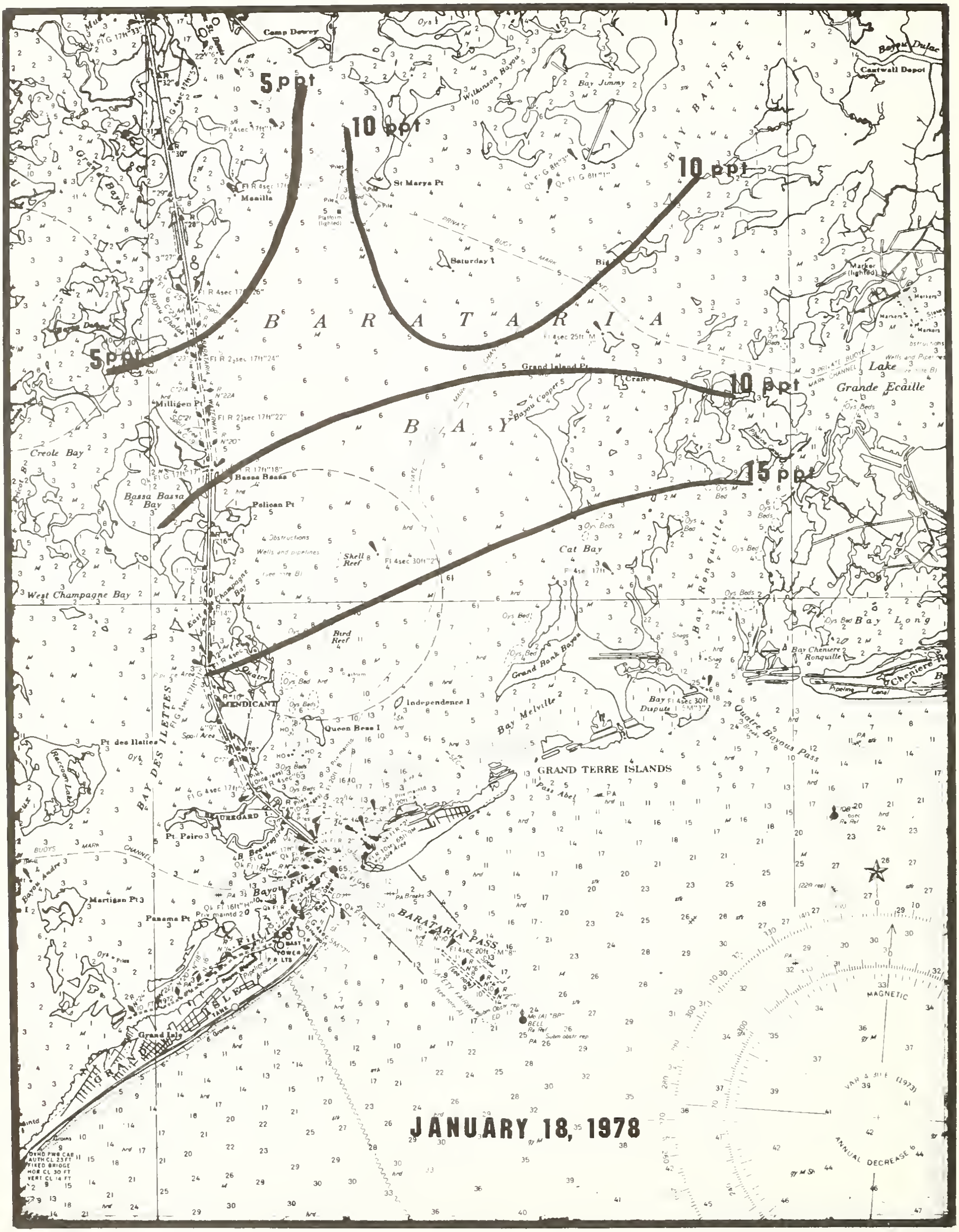

Figure 17. The January 18, 1978 bottom isohalines indicating a large area of trapped saline water in the upper part of Barataria Bay.

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SHORT PAPERS AND NOTES

Shell Deformity in the American Oyster *(Crassostrea virginica)* from Coastal Areas in Louisiana

by
RONALD J. DUGAS

Workers from shucking houses brought into the New Orleans office of the Louisiana Department of Wildlife and Fisheries during 1977 several oyster shells that contained large knobs on the interior surface (Figure 1). These oysters were obtained primarily from oyster leases in the coastal areas just west of the Mississippi River. The oyster were intact but were very much displaced and of smaller size than one would normally expect from a similar sized shell that was not so affected.

The deformity appeared to be stages of shell or foot disease as described by Galtsoff (1964) and Sindermann (1970). This is a fungal disease prevalent in European oyster communities. Galtsoff (1964) indicated the disease does occur in *Crassostrea virginica* along the Gulf Coast, but he did not consider it a threat to the fisheries here. The fungus infection is characterized by shell deformities, particularly greenish rubbery warts and knobs on the inside surface of the shell, especially in the region of the muscle attachment. The disease is very common in Europe where old shells are abundant. In the area where the deformed oysters were found, Mississippi River flooding (1973 through 1975) rejuvenated old reefs that had not been in production for several years.

In one shell (Figure 1), the large knoll dispaced virtually the entire shell cavity. There were only two oyster shell brought in with the knolls so advanced; the majority of shells had small, dark green knobs in the general area of muscle attachment. In relation to the large number of oysters shucked, the reported incidence was rare.

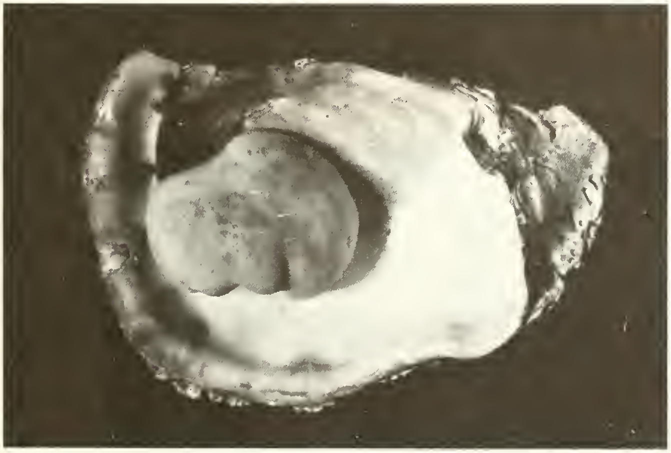

Figure 1. Photo of knobs on oyster shells.

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An Additional Record of Pugheadedness in the Spotted Seatrout *(Cynoscion nebulosus)*

by

STEPHEN HEIN AND JOEY SHEPARD

Pugheadedness has been recorded for various species of fish. In a series of papers, Gudger, during the late 1920's and throughout the 1930's, noted this anomaly in the brown trout, *Salmo trutta;* striped sea bass, *Roccus lineatus;* grunt, *Haemulon plumieri;* two-lined dab, *Lepidopsetta bilineata;* and a carp, presumably *Cyprinus carpio*. Others who noted this deformity were Isaacson (1965) in the black perch, *Embiotoca jacksoni;* Warlen (1969) in the Atlantic menhaden, *Brevoortia tyrannus;* Mansueti (1960) and Lyman (1961) in the striped bass, *Morone saxatilis;* Cheek (1965) in the American shad, *Alosa sapidissima;* Bortone (1971) in the Vermilion snapper, *Rhomboplites aurorubens;* and Bortone (1972) in the pirate perch, *Arphredoderus sayanus*.

The condition of pugheadedness was suggested by Mansueti (1960) to be induced by environmental conditions and heredity but not by physical injury.

There is only one known previous record of pugheadedness in the spotted seatrout, *Cynoscion nebulosus,* in Louisiana waters. It was noted by Rose and Harris (1969) and was an adult female caught by hook and line in Lake Chauvin, Louisiana, in 1968. The fish measured 302 mm standard length and weighed 438 grams. The fish in this report was also a female captured by hook and line. It was caught in October 1975 near Bay Gardene, Louisiana. The fish struck an artificial bait (shad rig) while feeding under a light at night. Standard length, as measured from the anterior-most portion of the head (lower jaw) to the posterior-most edge of the hypural plate, was 348 mm. Total length (as measured to the tip of the tail) was 413 mm. Total weight was 684 grams. A check of the stomach contents revealed an empty gut. This specimen is the largest known pugheaded spotted seatrout on record and the second one reported from Louisiana.

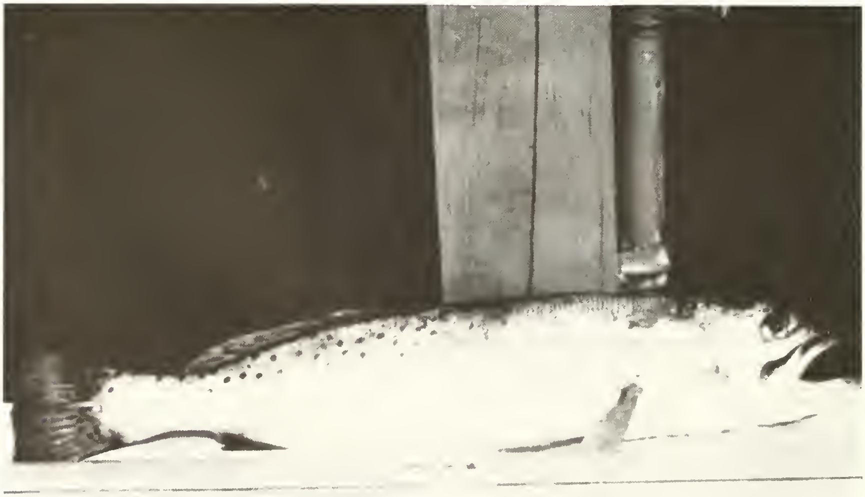

Figure 1. Photograph of pugheaded spotted seatrout *(Cynoscion nebulosus).*

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Growth of Juvenile Red Drum, *Sciaenops ocellata*, in a Quarter-acre Pond

by

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On October 16, 1978, a 12 foot by 4 foot by ⅛ inch square mesh nylon seine was pulled through a narrow drainage canal adjacent to the Marine Research Laboratory on Grand Terre Island. Approximately 1,000 juvenile red drum, *Sciaenops ocellata,* were captured in a series of short-duration seine drags. The fish were held in a 125-gallon nalgene tank and transported to a quarter-acre brackish water pond described by Broom (1968). Many fish exhibited signs of stress during the 45-minute interval between capture and stocking.

Nineteen fish were sampled for lengths and weight. Standard length averaged 21.7 mm and ranged between 13 and 34 mm. Total length averaged 27.2 mm and ranged between 17 and 42 mm. Weight averaged 0.24 grams and ranged between 0.05 and 0.75 grams.

A total die off occurred on January 3, 1979, as a result of cold pond water temperature and low pond water levels. All specimens were kept in the pond's catch basin, which is the deepest part of the pond. Eighty-six fish were removed from the pond to obtain measurements for the 79-day growing period. Standard length ranged between 46 and 79 mm, averaging 58.3 mm, and total length ranged between 57 and 99 mm, averaging 72.5 mm. Weight ranged between 1.91 and 10.13 grams, averaging 4.11 grams. Resultant growth was 0.92 mm total length per day and weight was 0.05 grams per day. Throughout the period, the temperature averaged 19°C.

Colura and Hysmith (1975) stocked larval red drum in quarter-acre to four-acre ponds. In nine ponds, from the beginning of August to the beginning of October, they reported a 1.02-1.33 mm per day range in growth at an average temperature of 26.1°C. One pond stocked on October 11 and harvested December 8 had a growth of 0.56 mm per day at an average temperature of 19.7°C.

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Occurrence of a Striped Bass *(Morone saxatilis)* on the Beach in Grand Isle, Louisiana

by

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On January 3, 1979, commercial fishermen captured a 2.95 kg. striped bass *(Morone saxatilis)* in a 500 foot, one inch bar mesh nylon seine on the Grand Isle, Louisiana, beach. The female fish measured 502 mm standard length and 601 mm total length. Stomach contents consisted of gulf menhaden *(Brevoortia patronus)*. Three other bass were reported from this area during 1978; however, identification of those specimens were never verified. As stated by Karas (1974), Louisiana is the western limit of distribution for the striped bass in the Gulf of Mexico.

Since 1975, the Department's Marine Research Laboratory has released approximately 125,000 fingerling bass throughout the Barataria Bay system, which drains into the Gulf. These releases have been accomplished through a federal aid project, AFC-6, entitled "To rear striped bass for release in an estuarine system." Other releases by this department have been concentrated north of the Barataria Bay complex in streams and rivers adjoining gulf outlets. During recent years, other gulf coast states have released bass in their estuarine systems and have recorded some returns. Tom McIlwain at the Gulf Coast Research Laboratory in Mississippi reported 258 returns between October 1977 and September 1978. (pers. comm. February 5, 1979).

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